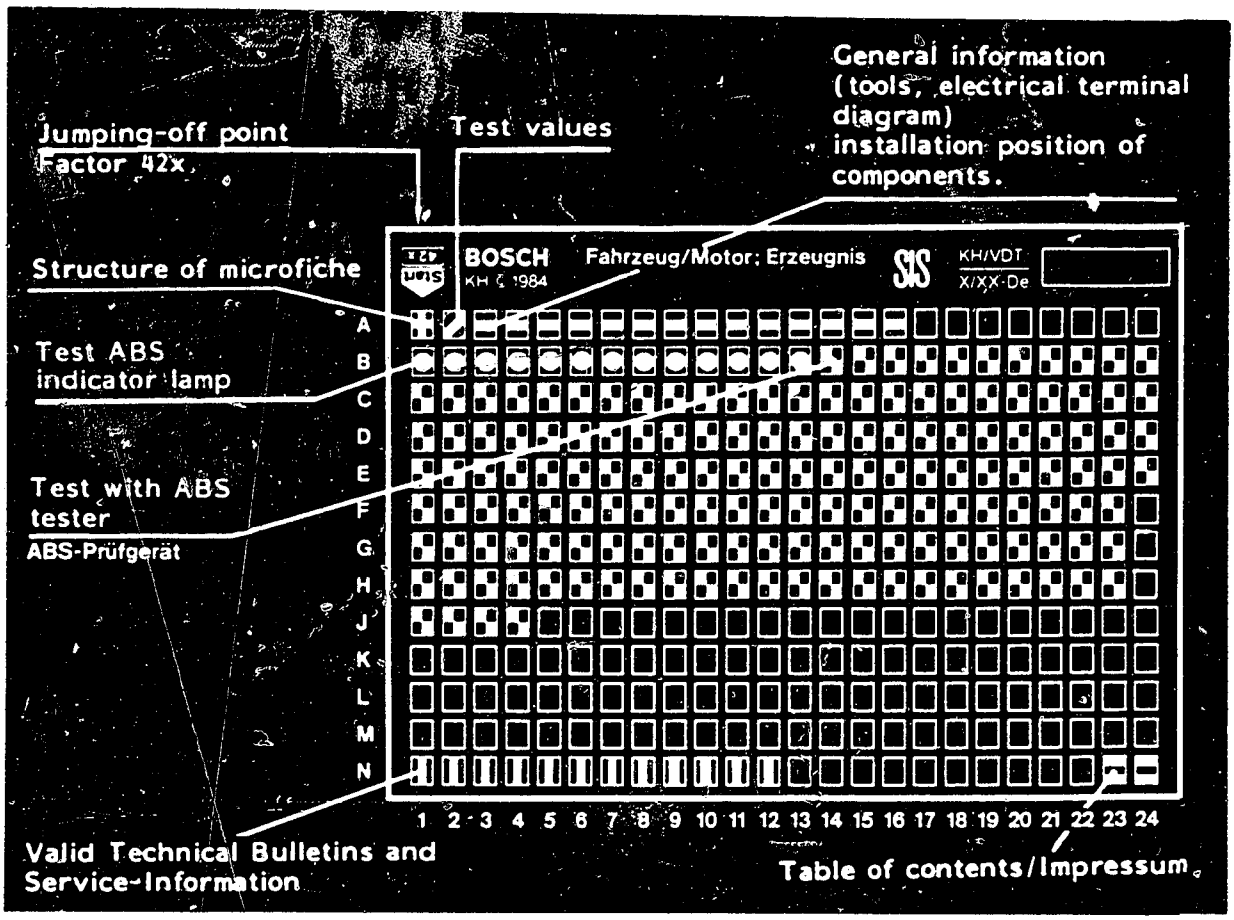
Structure of microfiche



1. Read from left to right

2. Title of microfiche (appears on each coordinate)

E16	Product/component/test step Vehicle/engine

Coordinate

3. Limits of section

➡	⬅➡	⬅	➡⬅
Beginning	Mid-section	End	One-page section

4. Purely vehicle-specific passages in the text are marked with a vertical bar.

5. Reference to relevant working steps in the test specifications, e.g. coordinate C6.

C6

1. TEST SPECIFICATIONS

For reasons of safety, the ABS must only be tested using the ABS tester.

The test program contains all the important information on testing and replacing the components.

2. TEST EQUIPMENT AND TOOLS

Description	Designation	Part No.
ABS tester Use only converted testers. Designation U2 on nameplate	ETT 016.00	0 684 101 600
Dynamic brake analyzer	e.g. BPS 100 or BPS 101 or BPS 104 or BPS 105	0 680 012 .. 0 680 013 .. 0 680 018 .. 0 680 019 ..
Charging and bleeding device		e.g. ATE Part No. 3.9302-1000.4 [1)]
Bleeder connection for connecting charging and bleeding device to fluid reservoir of master cylinder		ATE Part No. 3.9302-0740.2 [1)]
Bleeder hose		ATE Part No. 3.3590-2300.1 [1)]

1) Obtainable from:

Alfred Teves GmbH
Guerickestr. 7

6000 Frankfurt/Main

Description	Designation	Part No.
Auxiliary hose		ATE Part No. 3.9302.0704.2 [1]
Brake pedal actuating device		ATE Part No. 3.9312.0100.4 [1]
Pressure tester Tester for low-pressure and high-pressure testing of hydraulic brake systems		e.g. ATE Part No. 3.9305.0200.4 [1]
Double-end flare nut wrench 9 x 11 mm		Hazet Part No. 612 [2]
Vessel for catching the brake fluid approx. 1 l		
Brake fluid	Use only ATE genuine brake fluid DOT 4 or Opel brake fluid.	
Electrics tester or Multimeter for trouble-shooting	ETE 014.00	0 684 101 400 Commercially available
Feeler gauge For measuring wheel-speed sensor air gaps on rear axle		Commercially available

[1]) Obtainable from:
Alfred Teves GmbH
Guerickestr. 7

6000 Frankfurt/Main

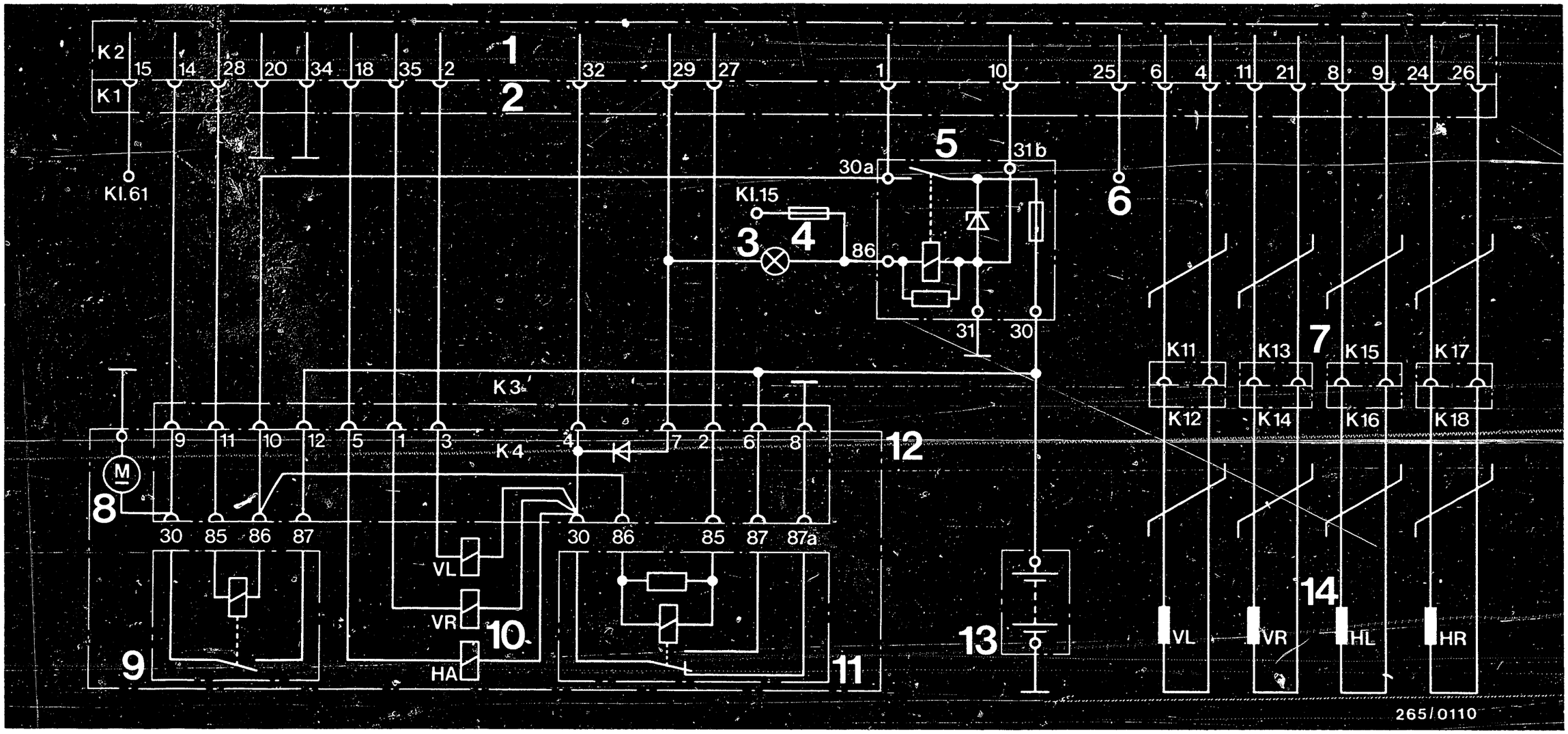
[2]) Fa. Hazet

5630 Remscheid

2.1 Aids

Use only genuine Opel brake lines.

Description	Part No.
Grease for wheel-speed sensors	Molykote Longterm 2
Protective caps for brake lines	Bosch Part No. 1 900 508 002 (100 pieces)
Shims in thicknesses 0.25 mm, 0.5 mm and 1.0 mm for rear-axle wheel-speed sensors	Opel service part



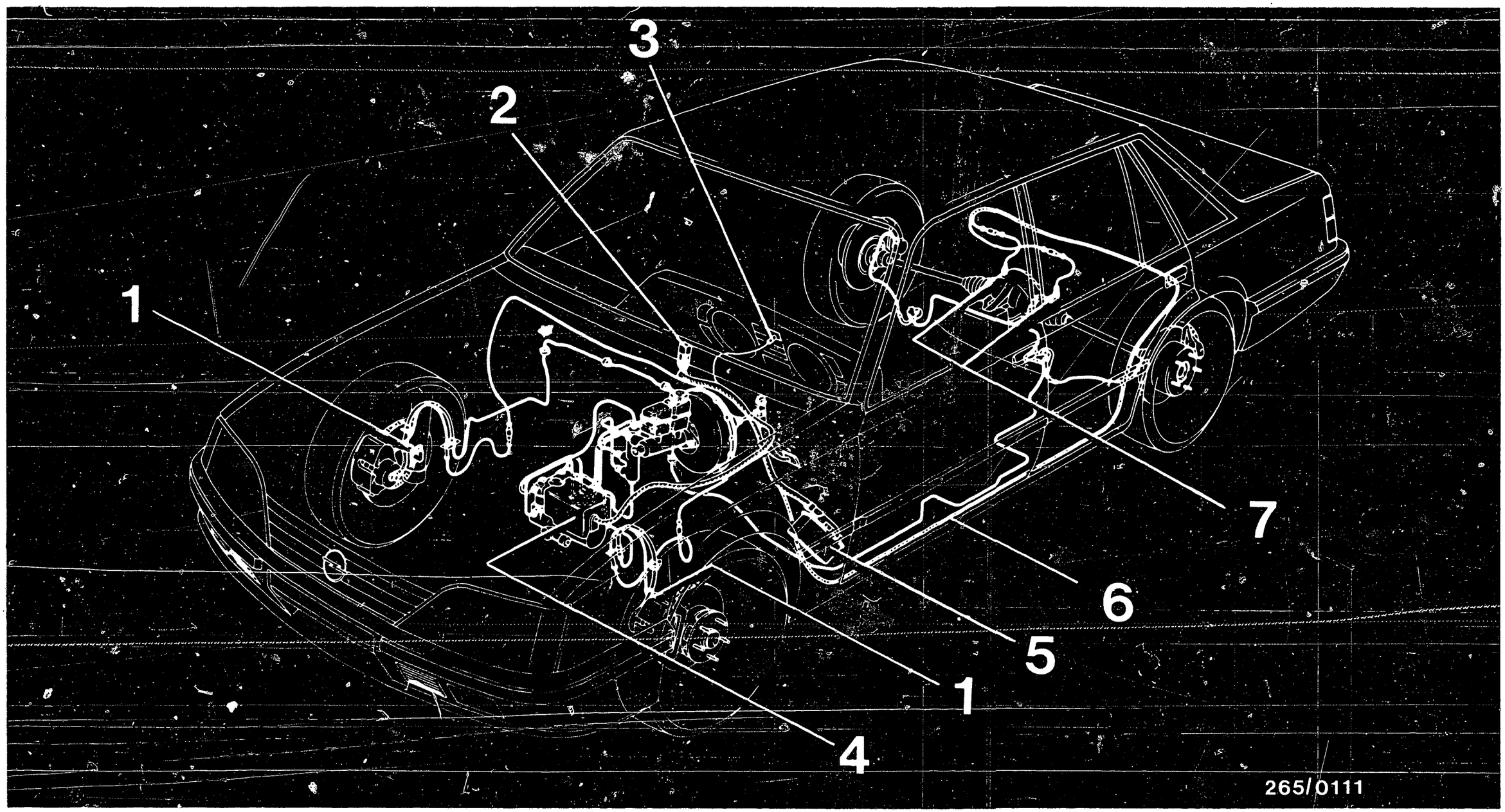
3. ELECTRICAL TERMINAL DIAGRAM

1 = Electronic controller
2 = Multiple plug (35-pin)
3 = ABS indicator lamp
4 = Fuse no. 6
5 = Overvoltage-protection relay
6 = To stop-lamp switch (+)
7 = Cable connector
8 = Return-pump motor
9 = Motor relay
10 = Solenoid-operated valves
11 = Valve relay
12 = Hydraulic modulator
13 = Battery
14 = Wheel-speed sensor
VL = FL = front left
VR = FR = front right
HA = RA = rear axle
HL = RL = rear left
HR = RR = rear right
K1 to K 18 = ABS plug connectors

4. INSTALLATION POSITION OF COMPONENTS

The indications "right" and "left" apply always as viewed in the forward direction of travel.

• ABS indicator lamp:	In instrument panel.
• Front-axle wheel-speed sensors:	One each on left and right in the steering knuckles.
• Rear-axle wheel-speed sensors:	One each on left and right on rear-axle drive.
• Hydraulic modulator:	In engine compartment on left in front of brake master cylinder.
• Common ground terminal for ABS and LE-Jetronic:	In intake manifold at rear on cylinder 6, near firewall.
• Controller:	In driver's footwell behind left-hand side panel.
• Overvoltage-protection relay:	In engine compartment, on left on firewall.



Installation position of components (continued)

1 = Front-axle wheel-speed sensor
2 = Overvoltage-protection relay
3 = ABS indicator lamp
4 = Hydraulic modulator
5 = Electronic controller
6 = ABS wiring harness integrated with LE-Jetronic wiring harness
7 = Rear-axle wheel-speed sensor

5. BLEEDING OF BRAKE SYSTEM

After replacing the hydraulic modulator, bleed brake system and perform high-pressure and low-pressure tests.

Take care when handling brake fluid!

a) Only pour brake fluid into containers where there is no danger of accidental human consumption of the fluid (fatal dose 100 cm^3).
b) Even slight traces of mineral oil cause the brake system to fail. If the brake fluid is colorless or yellowish pay particular attention since in this case the danger of a mix-up is at its greatest. If mineral oil is detected in the brake system or if there is a suspicion of same, the entire brake system must be thoroughly rinsed with brake fluid. The brake master cylinder must also be replaced.
c) Do not allow brake fluid to come into contact with the vehicle paintwork as it contains components which dissolve paint.
d) Brake fluid is highly hygroscopic, i.e. it absorbs humidity thus reducing the boiling point. Thus, brake fluid may only be stored in thoroughly sealed containers.

Note:
In the course of its service life the boiling point of the brake fluid drops due to the continuous absorption of humidity from the atmosphere. Thus, vapor bubbles may form in the brake system if the brakes are subjected to extremely heavy braking conditions. The brake fluid must therefore be replaced annually, preferably in the spring.

Bleeding

- When using a bleeding device for bleeding, pay attention to the manufacturer's operating instructions. In order to eliminate all air bubbles from the tandem brake master cylinder, the brake pedal must be completely depressed at least three times during the bleeding process with the bleeder screws open.

- If bleeding is performed by "pumping" with the brake pedal, close the appropriate bleeder screw each time before releasing the brake pedal to prevent air from being sucked in via the thread of the bleeder screw.

- Slowly release brake pedal to ensure that sufficient brake fluid is sucked in from the fluid reservoir during the return stroke of the plunger.

- The bleeding process is complete when clear, bubble-free brake fluid emerges via the bleeder hose.

Important!
The brake fluid pumped out during bleeding may not be reused since it may contain foreign matter which would then get back into the brake system.

- Fill fluid reservoir with brake fluid as far as "max" mark.

6. LEAK CHECK ON BRAKE SYSTEM

	High-pressure test
Line test pressure Gauge pressure	approx. 70...90 bar
Test duration	approx. 10 minutes
Pressure drop of set value	0 %

Note
The leak check must be performed in both brake circuits.

Test procedure

- Connect pressure tester to a fixed caliper. To do this, unscrew bleeder screw and screw in fitting. Then bleed pressure tester.

- Run engine at medium speed and create as high a vacuum as possible by suddenly releasing the accelerator.

- Using the brake-pedal actuating device, press in brake pedal until a line pressure between 70 and 90 bar gauge pressure is produced. Then hold brake pedal in this position.

- There must be no pressure drop during the test duration of 10 minutes. If a pressure drop is established, the leak must be found and eliminated, or the hydraulic modulator must be replaced.

7. GENERAL NOTES ON REPAIR WORK AND BRAKE SYSTEM

The ABS is basically maintenance-free, but when performing work on ABS-equipped vehicles, pay attention to the following:

1. If welding work is to be performed with an electric welding unit, the electronic controller plug must be removed.

2. During painting work the electronic controller may be subjected to a maximum of 95°C for brief periods and a maximum of 85°C for lengthy periods (approx. 2 hours).

3. After replacement of the hydraulic modulator, controller, wheel-speed sensors and wiring harness as well as work involving the ABS assemblies (e.g. work performed after accidents), the entire ABS system must be checked using the tester. Make absolutely sure that the brake lines are laid correctly.

4. After any work on the brake system, the brake system must be bled and high-pressure as well as low-pressure testing performed. All junctions are to be checked for leaks.

5. If the battery has been removed, the cable clamps at the two terminals must be properly tightened after reinstallation.

6. Do not use a fast charger for starting the engine.

7. Never disconnect the battery from the vehicle electrical system with the engine running.

8. Disconnect the battery from the vehicle electrical system when fast charging.

9. Make sure that all connectors of the wiring harness are securely connected.

10. Never connect or disconnect the wiring-harness plug of the controller with the ignition switched on.

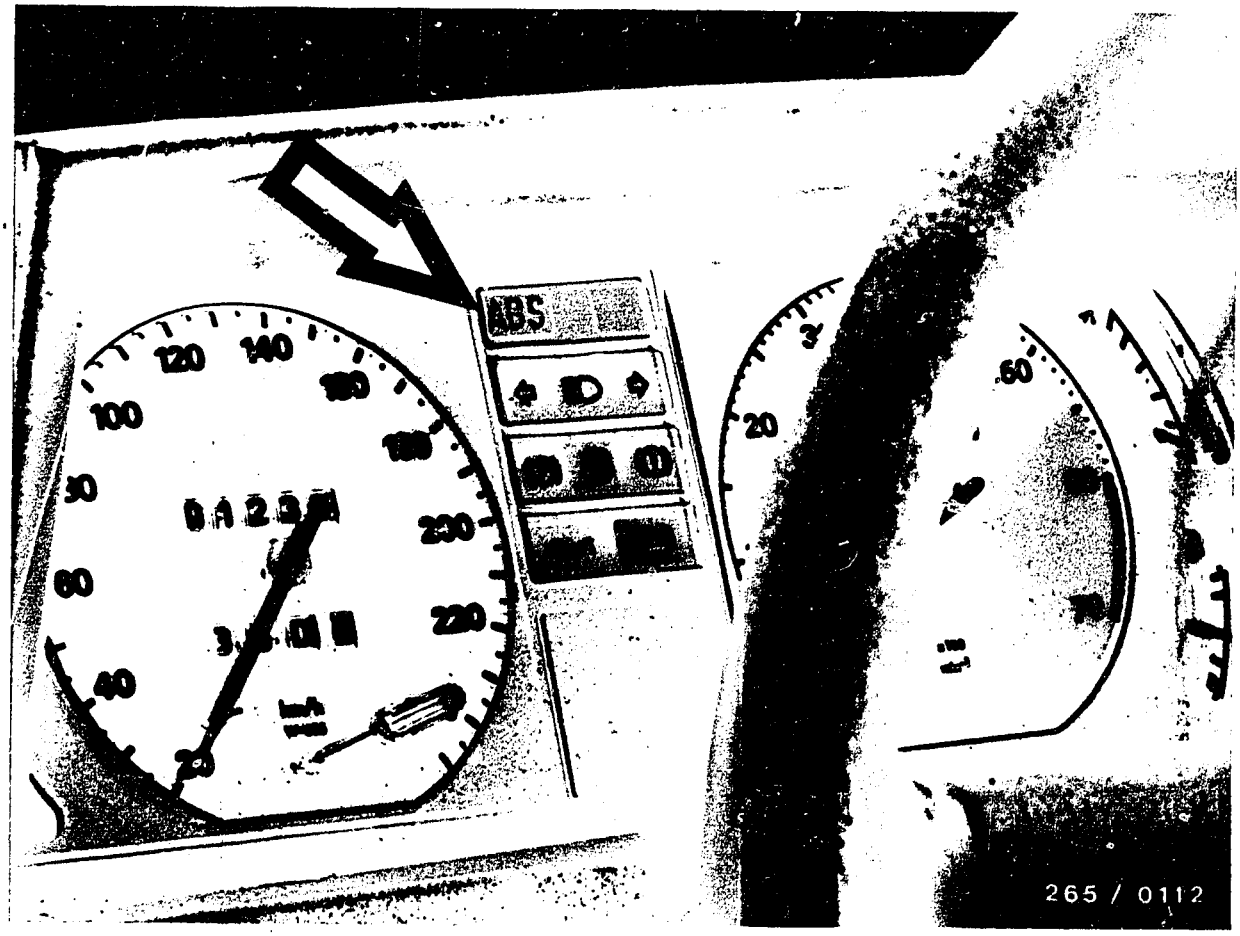
11. For safety reasons, the hydraulic modulator must not be repaired, but the complete unit must be replaced. Exceptions to this are the return-pump relay and the valve relay. Both relays may be replaced.
No screws on the hydraulic modulator may be loosened apart from the brake-line connections. After loosening it is no longer possible to get the brake circuits leak-tight! Danger!

8. FUNKTION AND CHECKING OF ABS INDICATOR LAMP

Vehicles equipped with ABS come into the workshop with one of the following customer complaints:

- Indicator lamp not lighting up after switching on the ignition.
- Indicator lamp not going out after reaching idle speed.
- Indicator lamp lighting up again when driving or lighting up occasionally.

Confirm the complaint yourself before checking the entire ABS system with the ABS tester. For reasons of safety, the ABS may only be checked using the ABS tester. The ignition must always be off for connecting the ABS tester as well as when connecting or disconnecting the controller. If you have detected a fault with the ABS tester, always disconnect the controller before performing further trouble-shooting.
In the following you are informed of the correct function and malfunction of the ABS indicator lamp.



Arrow = ABS indicator lamp

8.1 ABS indicator lamp

When the ignition is switched on the indicator lamp identified by the letters "ABS" lights up. After the engine has started and the idle speed has been reached the ABS indicator lamp goes out (terminal 61 of alternator supplies voltage to ABS controller).
When the vehicle exceeds a speed of approx. 6 km/h with all 4 wheels for the first time after starting, the ABS system performs a self-check (BITE sequence).
This process is repeated each time the ignition is switched off and the engine is started again.
In addition, the ABS constantly checks itself to a certain extent while driving.

Incorrect indicator lamp indications are:

- Indicator lamp not lighting up after switching on the ignition.
- Indicator lamp not going out after reaching a idle speed.
- Indicator lamp lights up again while driving or lights up occasionally.

The lighting up of the ABS indicator lamp tells the driver that the ABS it not in working order. Nevertheless, the conventional brake system is still available. However, locking of the wheels is possible.

General note

Occasional lighting up of the indicator lamp may be caused by an insufficiently charged battery. The lamp only lights up as long as there is undervoltage, e.g. after switching on loads at idle.

The causes of trouble are to be established with the aid of the ABS tester and a dynamic brake analyzer.

9. ABS TESTER

The tester checks functions of the controller, of the hydraulic modulator, of the wiring harness and also checks the components of the antiskid system (ABS).

The ABS tester measures actual values which are compared with the respective nominal values.

If the actual value indicated differs from the nominal value, carry out trouble-shooting as directed in the "trouble-shooting" column.

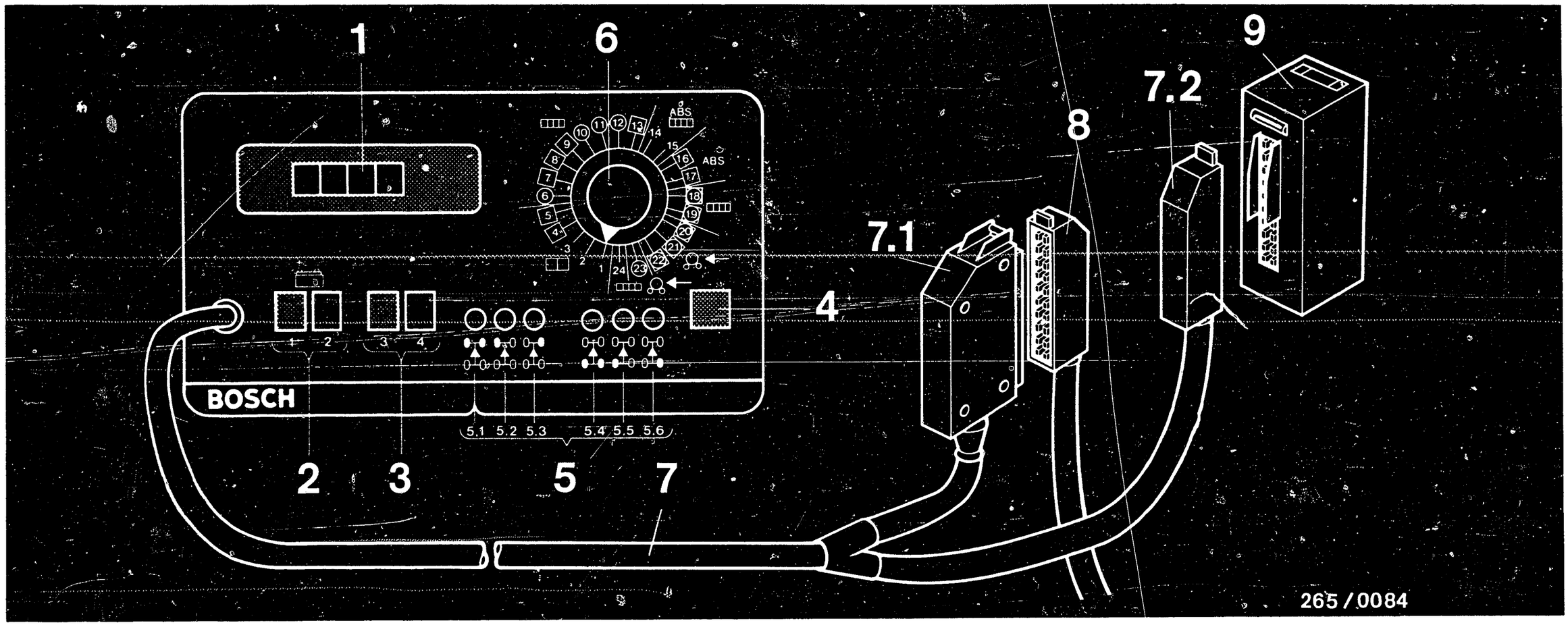
Connect the ABS tester between the controller and the ABS wiring harness (switch off the ignition to connect the tester).

Do not drive the vehicle with the tester connected.

The respective test steps are set with the program-selector switch (1 to 24).

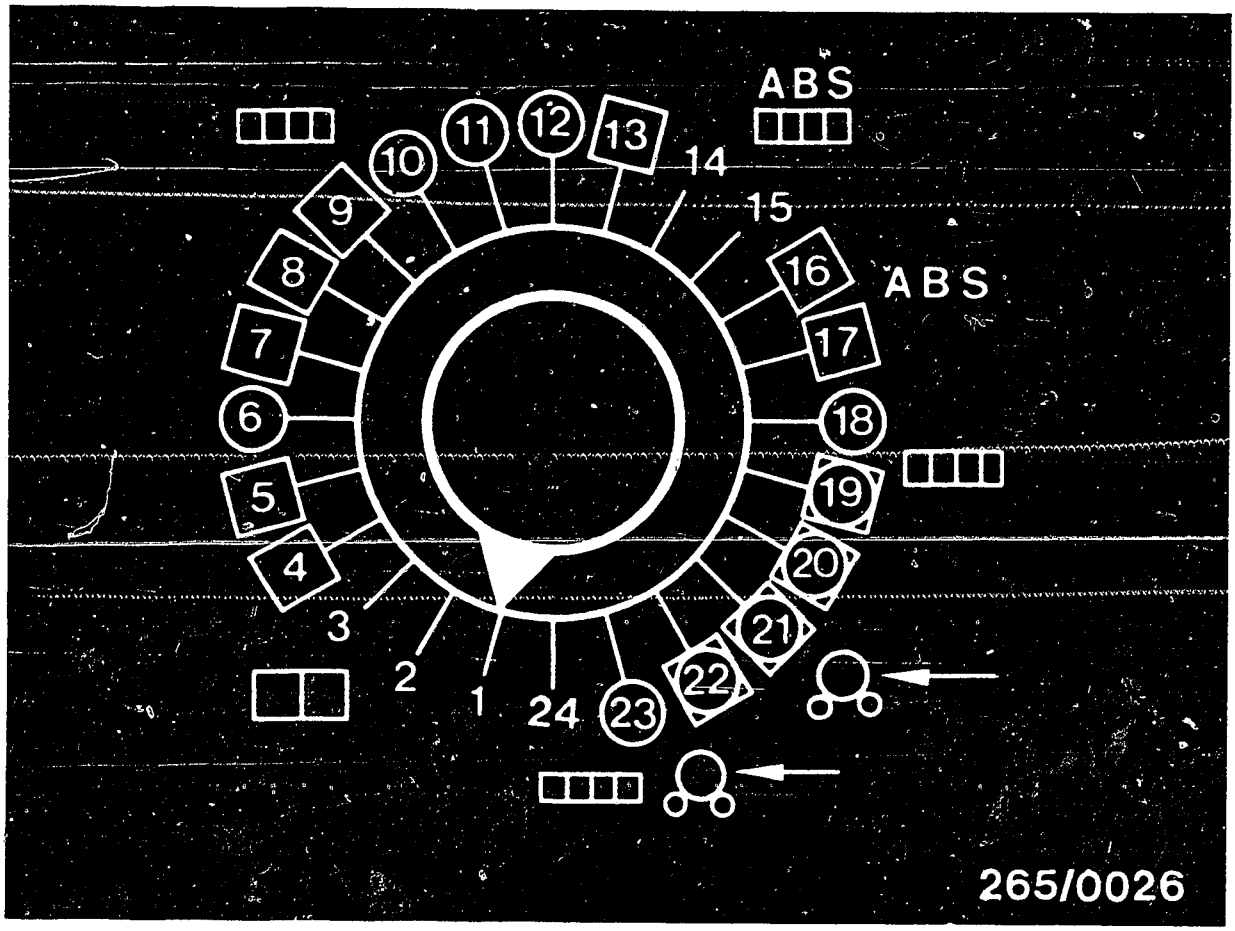
For the wheel-speed sensors and the hydraulic modulator depress the round buttons according to the test chart.

Test steps with a high power requirement are not triggered until after the illuminated key has been pressed.
The illuminated key lights up automatically in the respective test steps.
The acutal value is indicated either by the green-red-lamps or by the digital display.
The test steps with the program-selector switch in positions 20...23 can only be performed on a dynamic brake analyzer.
For generations 2B it is absolutely necessary that the tester has been converted to meet the latest requirements.
Note designation "U2" on nameplate.



ABS-tester

1 = Digital LED display unit
2 = Lamp 1 (green): battery voltage O.K.
= Lamp 2 (red): battery voltage too low
3 = Lamp 3 (green): return-pump relay and valve relay as well as overvoltage protection O.K.
= Lamp 4 (red): return-pump relay and valve relay as well as overvoltage protection defective
4 = Illuminated key, yellow, for triggering individual test steps
5 = Channel selection key (wheel selection)
5.1 = Front axle (FA)
5.2 = Front left wheel (FL)
5.3 = Front right wheel (FR)
5.4 = Rear axle (RA)
5.5 = Rear left wheel (RL)
5.6 = Rear right wheel (RR)
6 = Program-selector switch
7 = Connecting cable
7.1 = Connection to wiring harness
7.2 = Connection to controller
8. = Multiple plug of vehicle wiring harness
9 = ABS controller (installed in vehicle)



Program-selector switch (description of symbols)

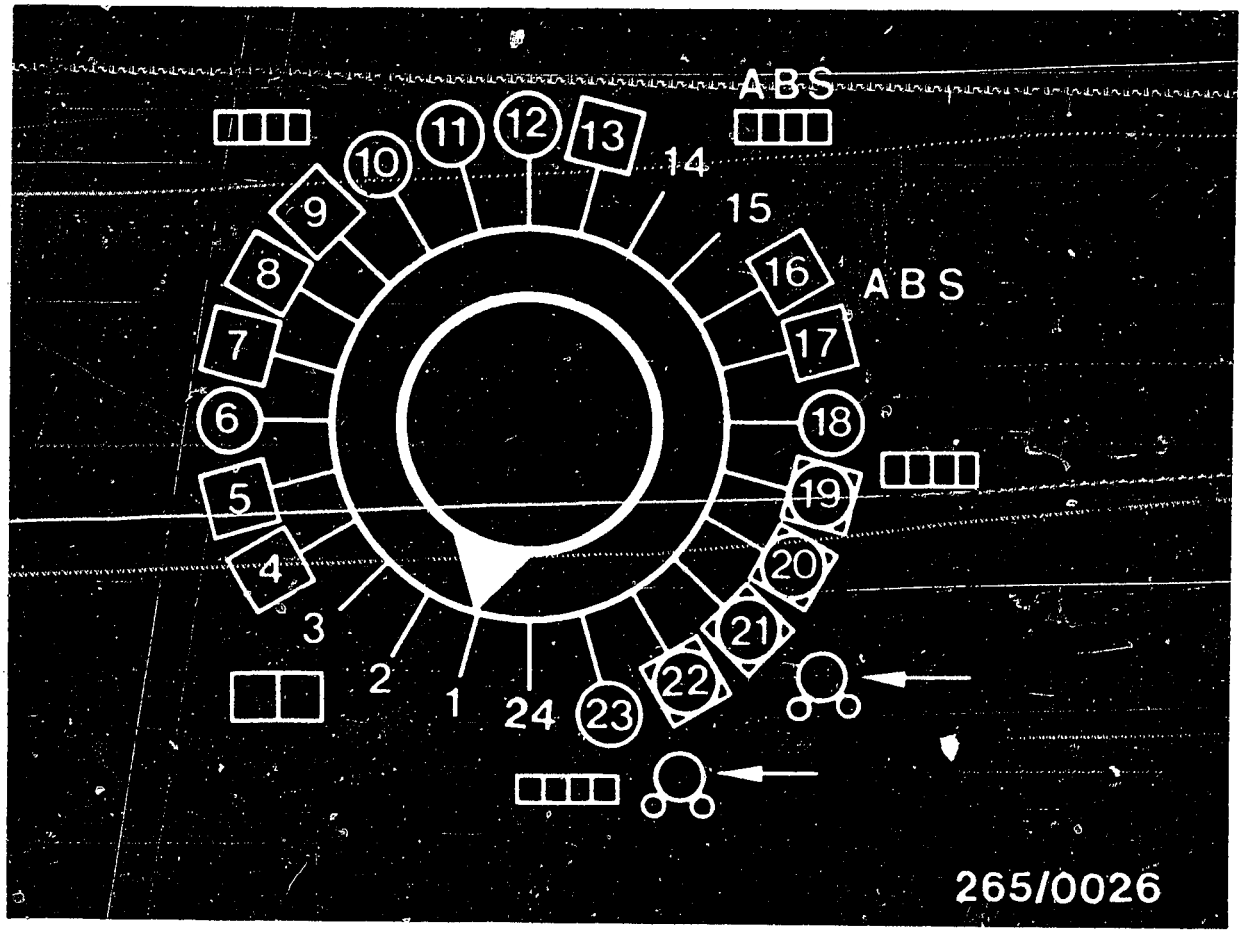
Program-selector switch for 24 program steps
Symbols for additional operations:

Program step with □ : press illuminated key (Item 4)

Program step with ○ : press respective channel selection keys (Items 5.1 to 5.6)

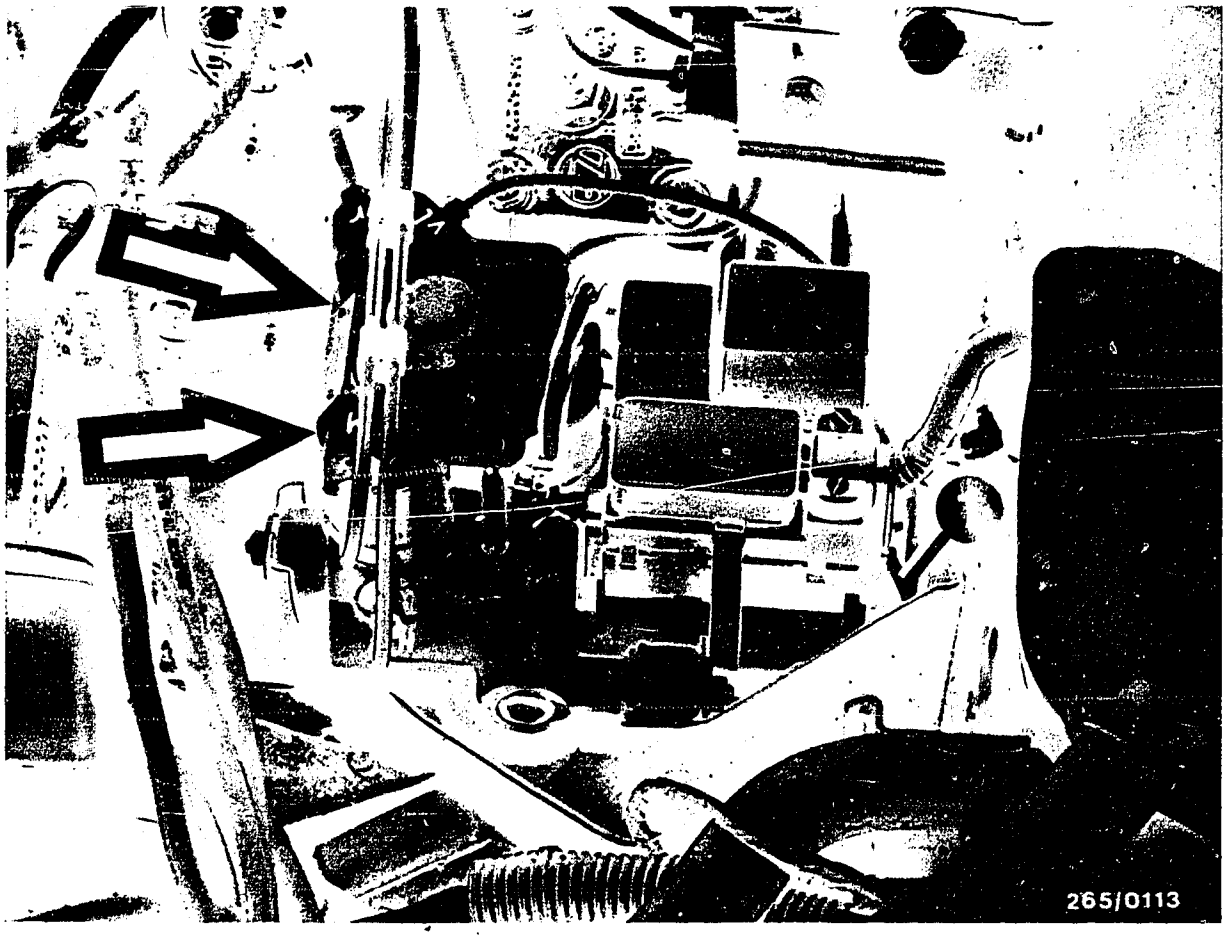
Program step with ▢ : press channel selection key (Items 5.1 to 5.6), press illuminated key (Item 4)

Program step with : first drive front axle and then rear axle of vehicle onto dynamic brake analyzer.



Program-selector switch (description of symbols) (continued)

Display:	Red-green display, lamp units (Item 2 or Item 3)
:	Digital display unit (Item 1)
ABS :	Watch indicator lamp in vehicle.



1 = Ground connection of return pump
Arrows = Joints

10. TEST CONDITIONS FOR TESTING WITH ABS TESTER

- Check ground connection of return pump for security.
- Check ground strap between engine block and vehicle frame (front right) for security.
- Check hydraulic connections on hydraulic modulator and joints (arrows) for leaks (visual inspection).

- If the ABS indicator lamp lights up occasionally when driving (e.g. after switching on loads) and goes out again automatically, check the battery and the power supply (generator, regulator and voltage drops).

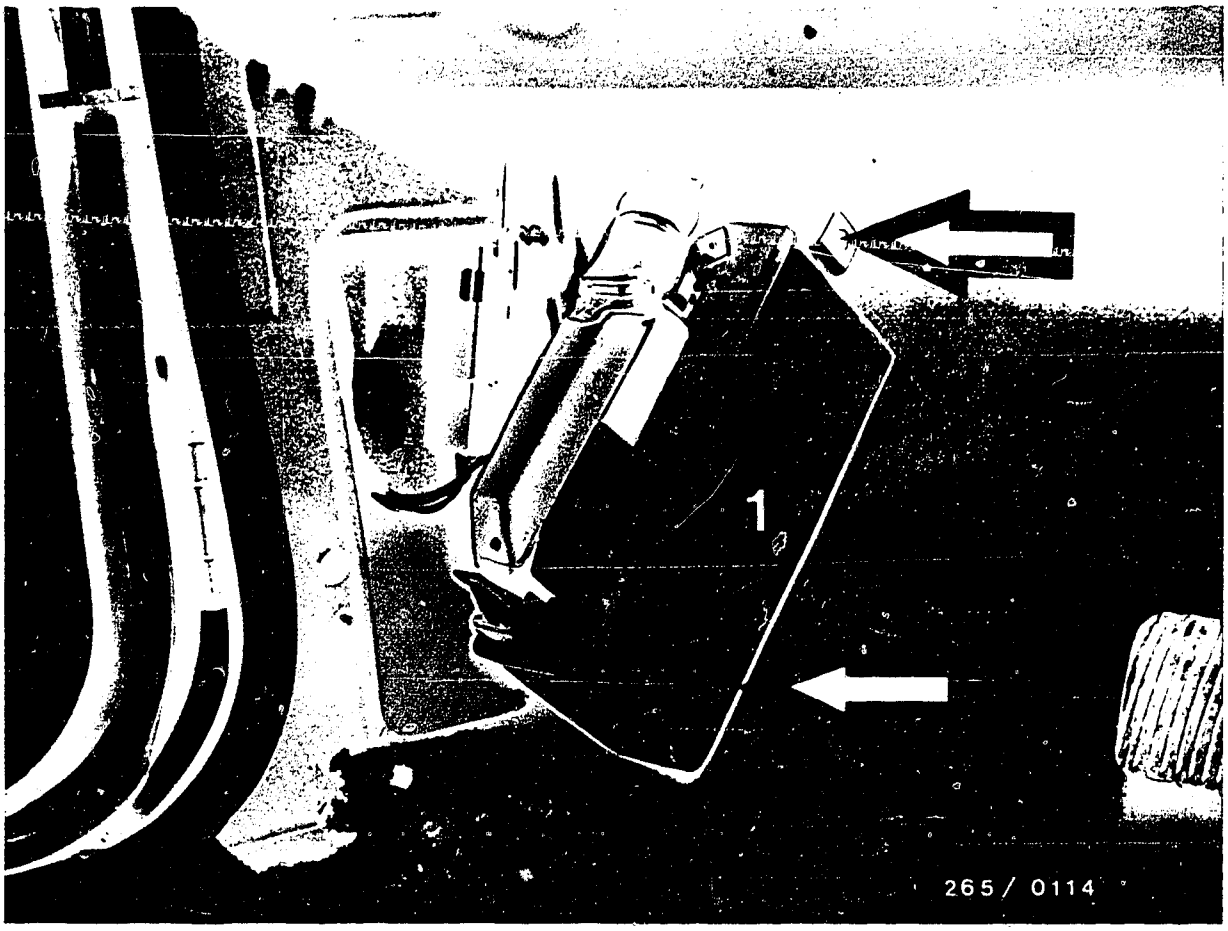
- If the ABS indicator lamp lights up constantly and does not go out, check the following points:

→ Is the multiple plug correctly fitted to the controller and has it locked in position?
Are all plug contacts O.K.?
Have the spring contacts locked in position?

→ Has the V-belt broken? (generator not providing any power, charge indicator lamp and ABS indicator lamp light up).

→ Is there voltage at generator terminal 61?
Plug connector and cable to ABS controller O.K.?

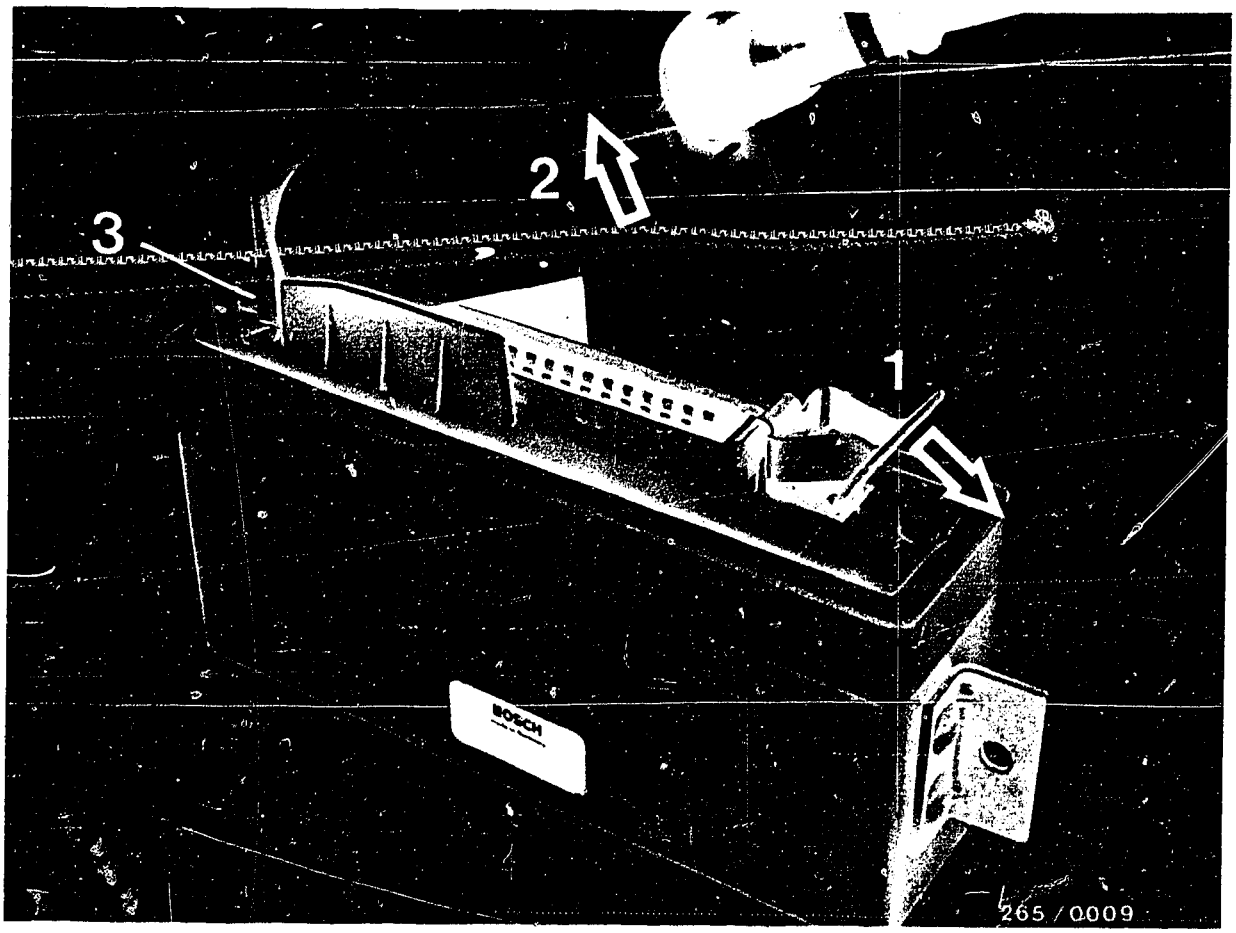
→ Pay particular attention to testing for loose contacts on wheel-speed sensors with program-selector switch in position 10.



1 = ABS controller
Arrows = Fastening screws

- Connect ABS tester to controller and ABS wiring harness.
 Caution
 Connect and disconnect controller only with ignition off.

 The controller is installed in the driver's footwell on the left.
 To remove the controller, loosen fastening screws and take out controller.



1 = Spring
2 = Multiple plug (35-pin)
3 = Encoding block

Switch off ignition before disconnecting multiple plug.

Press back spring, hinge up multiple plug and unhook from encoding block.

- For testing with the tester, switch on the ignition in all program-selector switch positions (tester operates on power supply from vehicle battery)

- Watch tester lamps 1 and 2 in all program-selector switch positions.

Caution!

Do not drive the vehicle with the tester connected!

Repeat the entire test program after any repairs.

General note on trouble-shooting

Check all cables for short circuit to ground and for contact with positive cables, and watch for any indications of wear, abrasion and pinching.

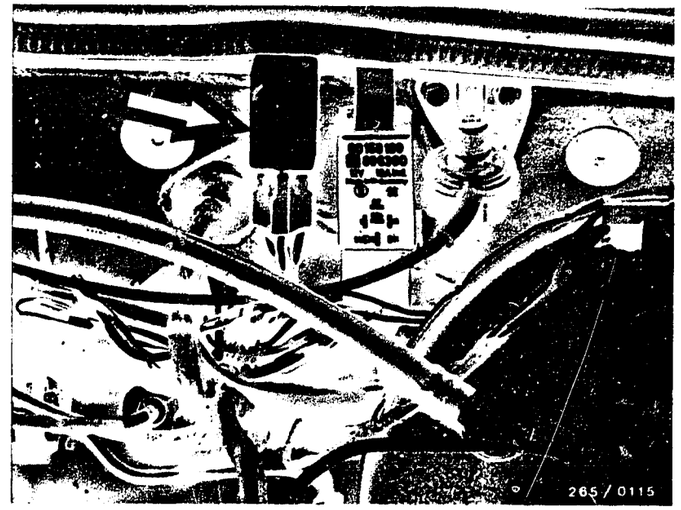
11. TESTING WITH THE ABS-TESTER

Note on test steps 1 ... 45

In the following test steps a broad, white surrounding frame in the "Operation" column indicates which operation has to be changed compared with the preceding test step.

TEST STEP 1 Note: This test step is important for all the following test steps, i.e. watch lamps 1 and 2 throughout the entire test procedure.

Operation:		Reading:	Testing:
Program-selector switch position	1 to 24	Lamp 1 (green) must light up	Component: Power supply
Operation in vehicle: Switch on ignition		Note: Lamp 1 (green) = O.K. Lamp 2 (red) = fault. Watch for occasional lighting up. If reading O.K., continue testing with next test step.	Operation: Monitoring of power supply in all program-selector switch positions. Malfunktion: 1. No reading. 2. Green lamp goes out and red lamp lights up, possibly only briefly as long as there is undervoltage



Arrow = Overvoltage protection relay

Trouble-shooting (switch off ignition):

1. No reading:
- Fuse no. 6 in fuse box defective.
- Multiple plug not correctly connected.
- Overvoltage-protection relay defective - replace.

Check the following leads:
- Positive lead from B+ to overvoltage-protection relay term. 30.
- Negative lead from overvoltage-protection relay term. 31 to ground.

Continued on B17/B18

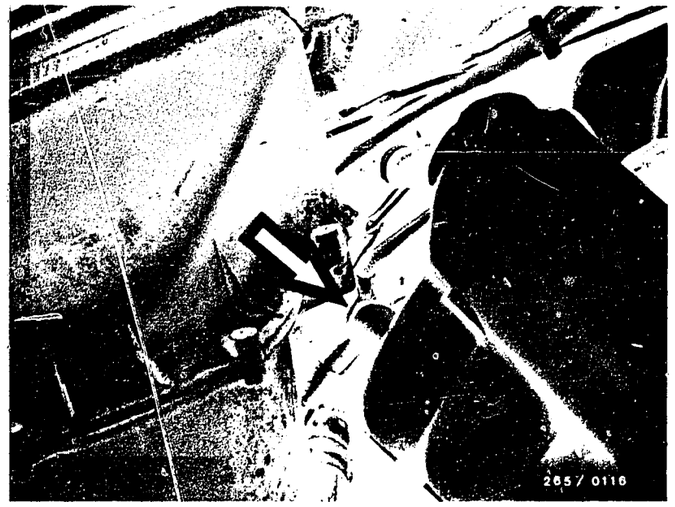
Trouble-shooting - TEST STEP 1 (continued)

- Negative lead from overvoltage-protection relay 31b to multiple plug term. 10.
- ABS ground terminal must be bare down to the metal and must not have any contact resistance.
- Positive lead from overvoltage-protection relay term. 30a to multiple plug term. 1.
- Positive lead from overvoltage-protection relay term. 86 to driving switch term. 15.
- Check ground strap between engine block (front right) and vehicle frame for security.

Lamp 2 (red) lights up or lights up occasionally during testing:
Stop test and eliminate cause of trouble.

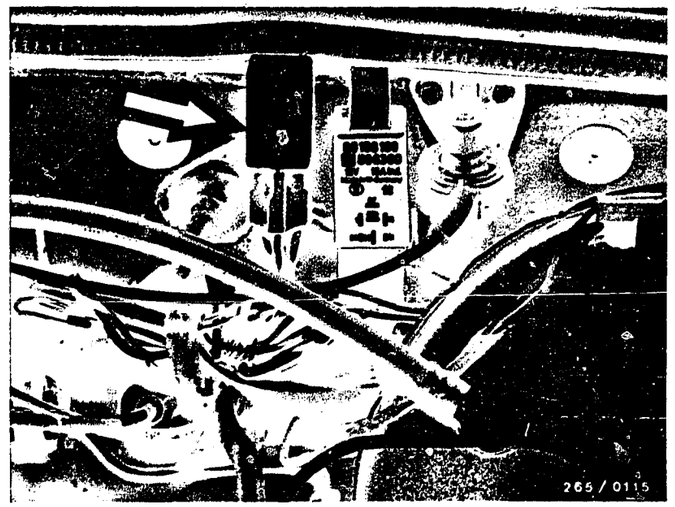
Causes of trouble:
1. Battery insufficiently charged. Charge battery or let engine run.
2. High voltage drops across ABS ground terminals. Ground terminals must be bare down to the metal.

After remedying fault, perform complete test program



Arrow = Ground terminal for ABS and L-Jetronic

Arrow = Overvoltage protection relay



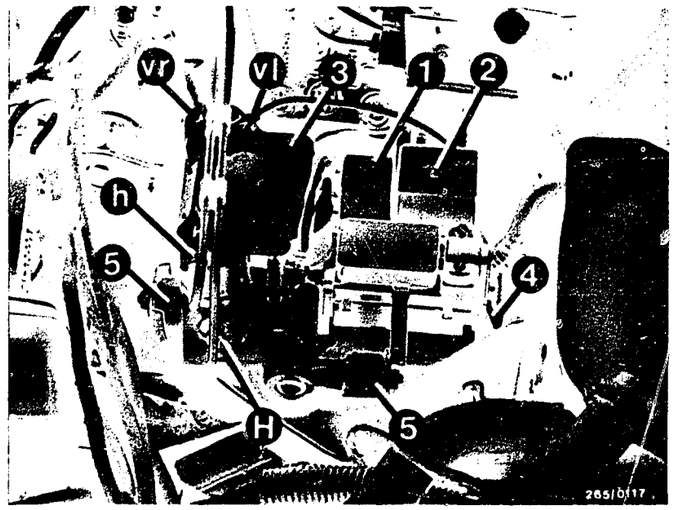
TEST STEP 2

Operation:		Reading:	Testing:
Program-selector switch position	1	Lamp 3 (green) must light up	Component: Valve relay
Operation in vehicle: Switch on ignition			Operation: Off-position
		If reading O.K., continue testing with next test step.	Malfunction: Lamp 4 (red) lights up

Trouble-shooting (switch off ignition):

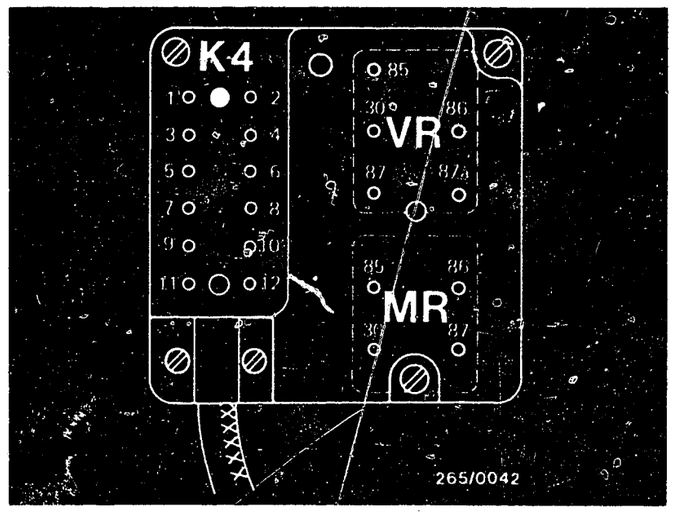
- No reading: fuse no. 6 in fuse box defective.
- Valve relay defective.
 Caution! Use only relay with correct electrical terminal assignment.
- Ground connection has high contact resistance or open circuit.
- Test the following cables for continuity:
 From ground to plug K 3/term.8
 From K4/term.8 to valve relay term.87 a
 From K4/term.12 to valve-relay plug term.30
 From K3/term.12 to multiple plug K1/term.32

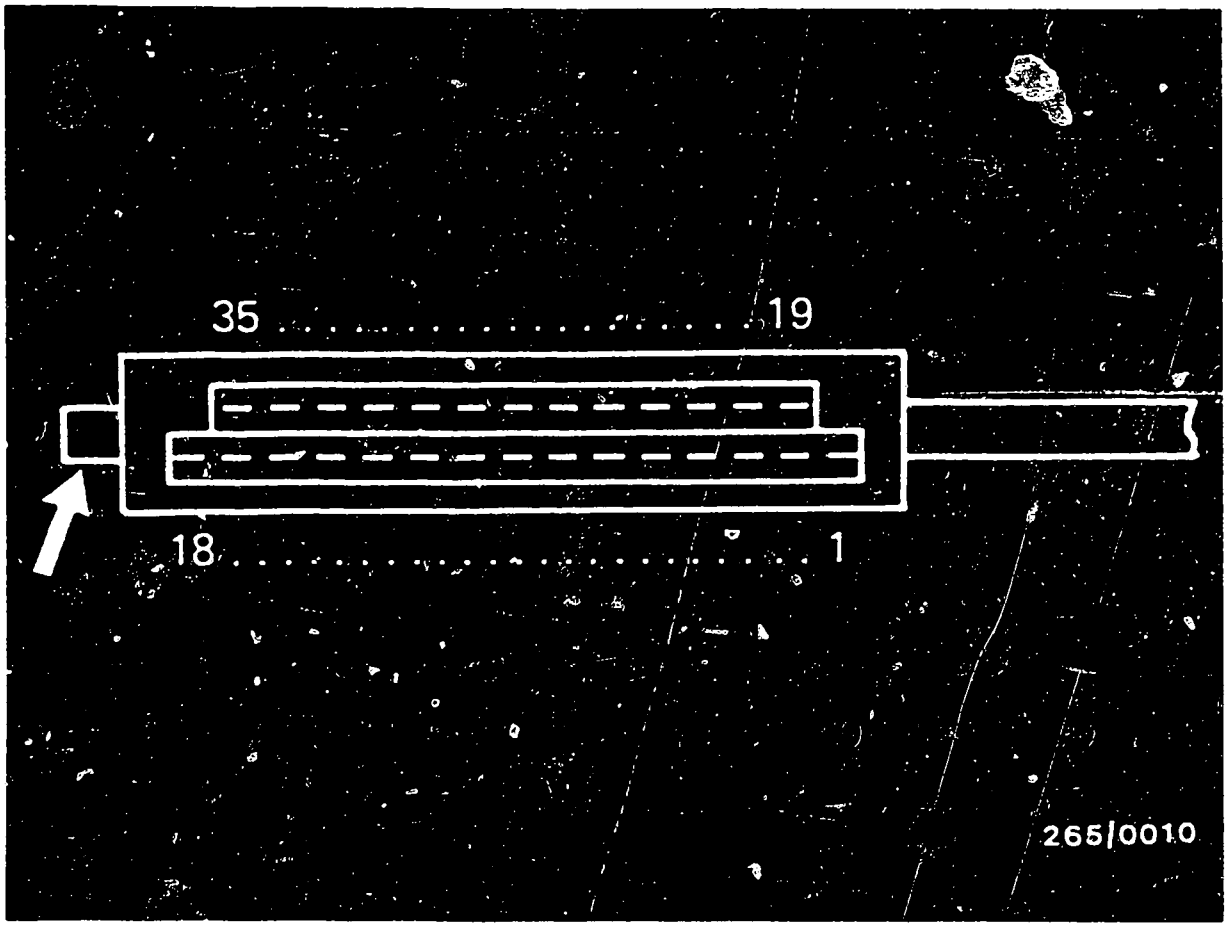
Continued on B 21



1 = Valve relay
2 = Motor relay

Top view of plug-in plate of hydraulic modulator.
Position of terminals:
VR = Valve relay
MR = Motor relay
K4 = Wiring-harness plug





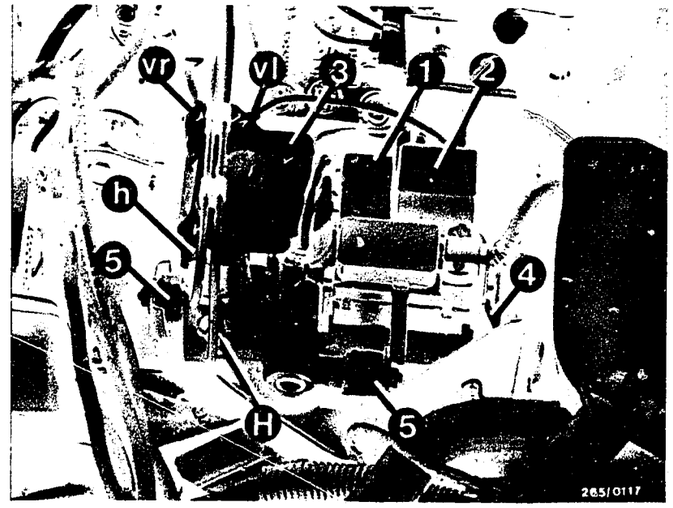
Trouble-shooting for TEST STEP 2 (continued)

Top view of multiple plug K 1 (35-pin) with terminal numbers.

Arrow = Lug with mechanical coding

TEST STEP 3

Operation:		Reading:	Testing:
Program-selector switch position	2	Lamp 3 (green) must light up	Component: Valve relay
Operation in vehicle: Switch on ignition			Operation: Relay make contact
		If reading O.K., continue testing with next test step.	Malfunction: Lamp 4 (red) lights up



1 = Valve relay
2 = Motor relay

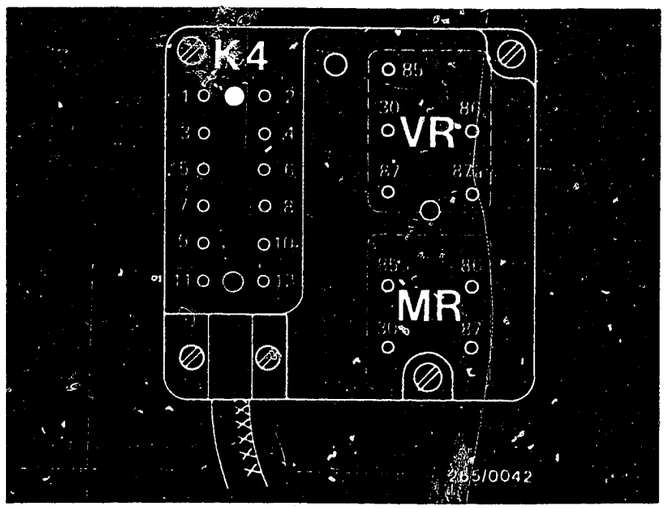
Top view of plug-in plate of hydraulic modulator.
Position of terminals:
VR = Valve relay
MR = Motor relay
K4 = Wiring-harness plug

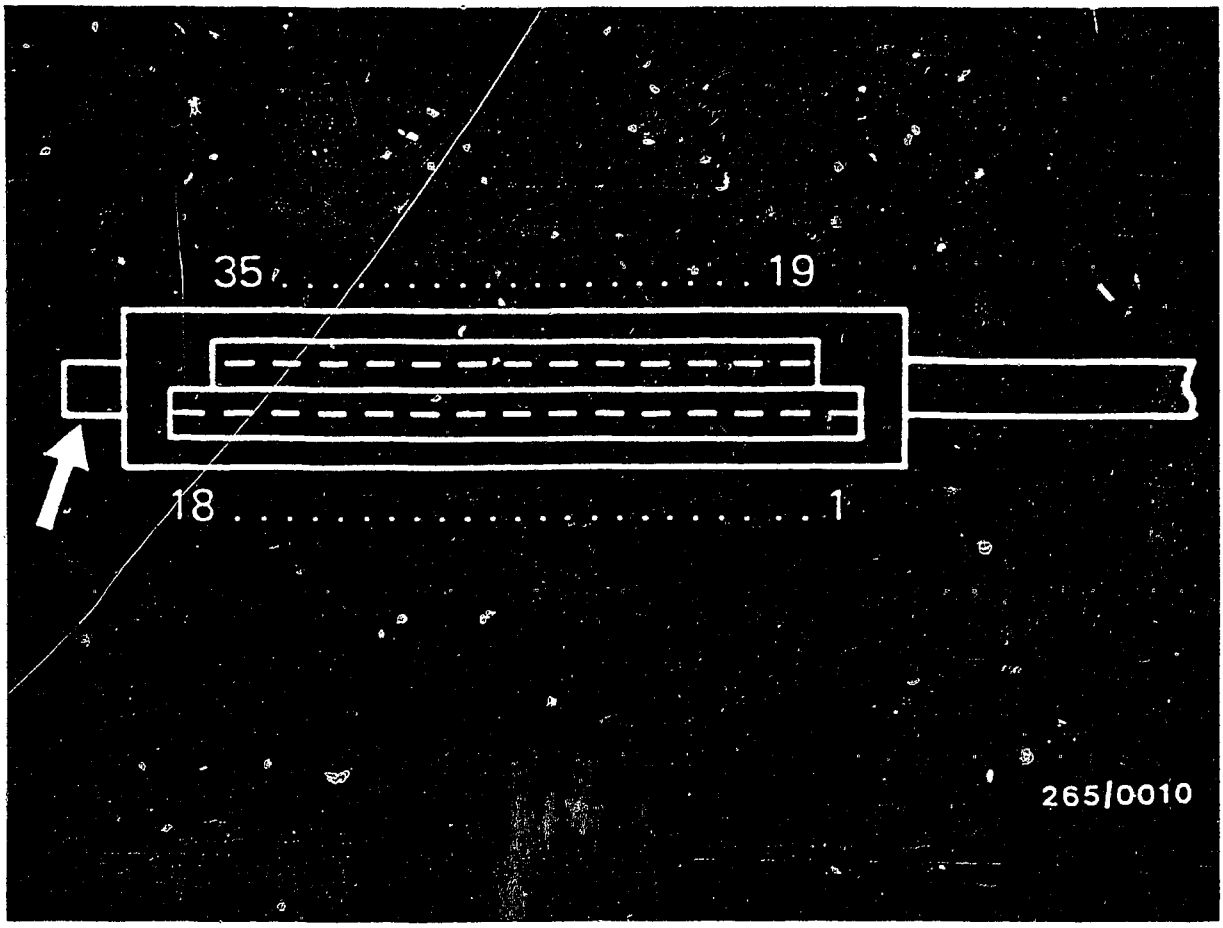
Trouble-shooting (switch off ignition):

- No reading: fuse no. 6 in fuse box defective.
- Valve relay defective.
 Caution! Use only relay with correct electrical terminal assignment.
- Ground connection has high contact resistance or open circuit.
- Test the following cables for continuity:

 From term. B+ to plug K3/term.6
 From K4/term.6 to valve relay term.87
 From K3/term.2 to multiple plug K1/term.27
 From K4/term.2 to valve relay term. 85
 From valve relay term.86 to motor relay term.86
 From motor relay term.86 to K4/term.10
 From K3/term.2 to overvoltage-protection relay term. 30a.

Continued on B 24





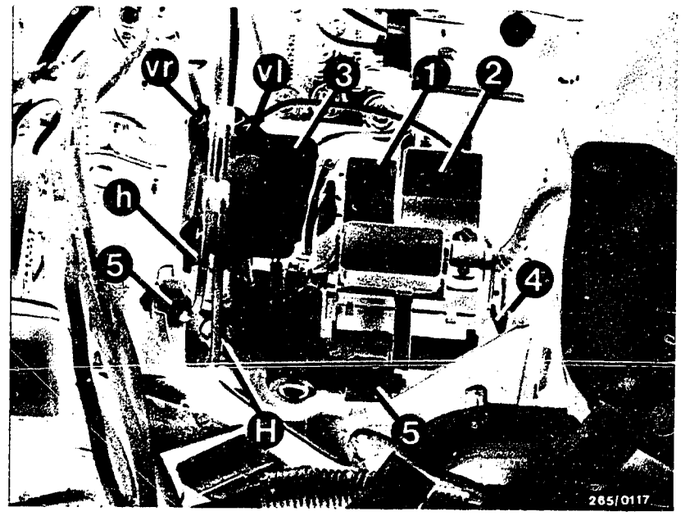
Trouble-shooting for TEST STEP 3 (continued)

Top view of multiple plug K 1 (35-pin) with terminal number

Arrow = Lug with mechanical coding.

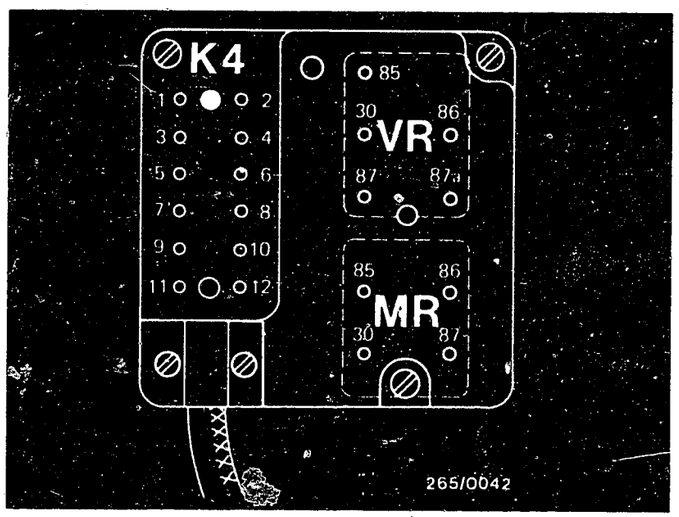
TEST STEP 4

Operation:		Reading:	Testing:
Program-selector switch position	3	Lamp 3 (green) must light up	Component: Return-pump relay
Operation in vehicle: Switch on ignition			Operation: Off-position
		If reading O.K., continue testing with next test step.	Malfunction: Lamp 4 (red) lights up



1 = Valve relay
2 = Motor relay

Top view of plug-in plate of hydraulic modulator.
Position of terminals:
VR = Valve relay
MR = Motor relay
K4 = Wiring-harness plug

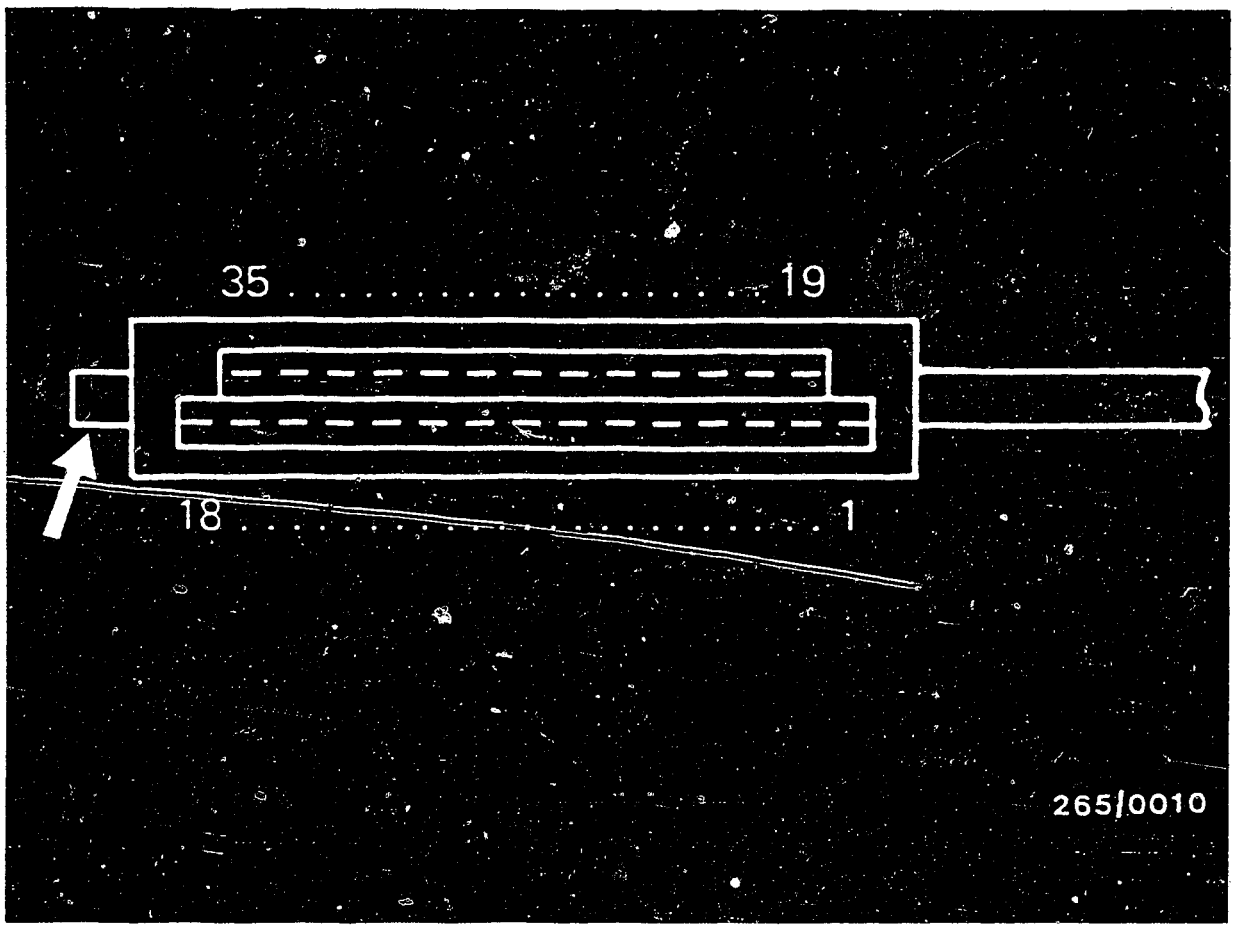


Trouble-shooting (switch off ignition):

- Return-pump relay defective.
- Check ground terminals of pump motor for security and contact resistance.

- Test the following cables for continuity:
 From multiple plug K1/term. 14 to plug K 3/term. 9.
 From K 4/term. 9 to return-pump relay term. 30 and to positive terminal of pump motor.
- Check positive terminal of pump motor for security. Check pump motor for continuity. If no continuity, continue testing with test step 5.

Continued on C 3



Trouble-shooting for TEST STEP 4 (continued)

Top view of multiple plug K 1 (35-pin) with terminal numbers.

Arrow = Lug with mechanical coding

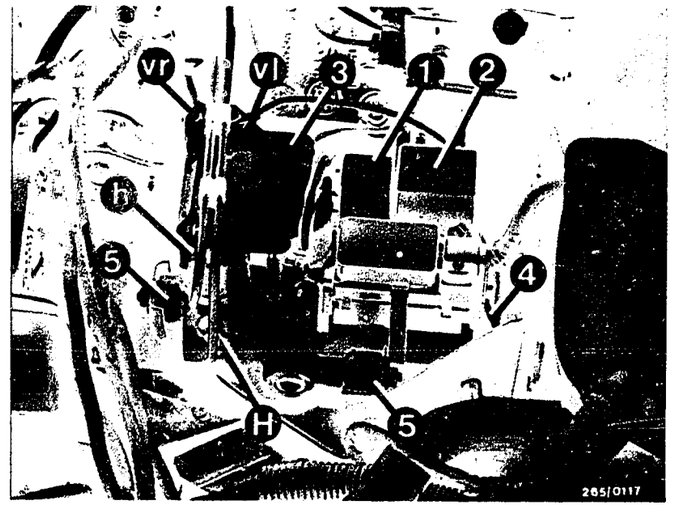
TEST STEP 5

Operation:		Reading:	Testing:
Program-selector switch position	4	Lamp 3 (green) must light up Pump motor can be heard to operate.	Component: Return-pump relay
Illuminated key lights up press key	●		Operation: Relay make contact
Operation in vehicle: Switch on ignition		If reading O.K., continue testing with next test step.	Malfunction: Lamp 4 (red) lights up

Trouble-shooting (switch off ignition)

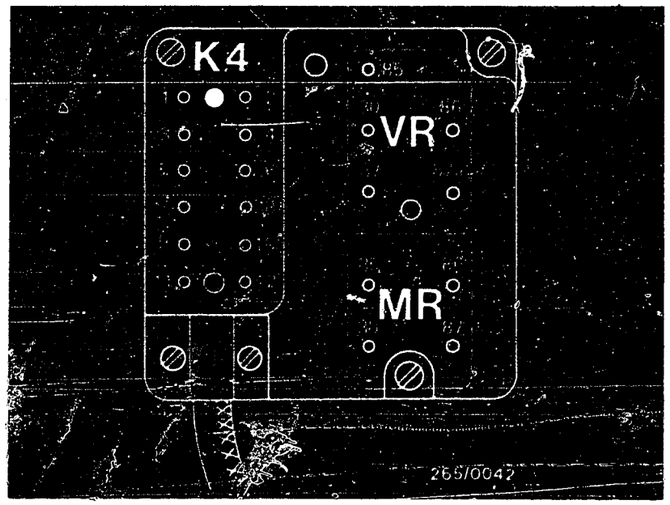
- Return-pump relay defective.
- Test the following cables for continuity:
 From multiple plug term.85 to K4/term.11
 From K3/term.11 to multiple plug K1/term.28
 From return-pump relay term.87 to K4/term.12
 From K3/term.12 to term.B+
- Pump motor not operating:
 Continue testing with test step 6.

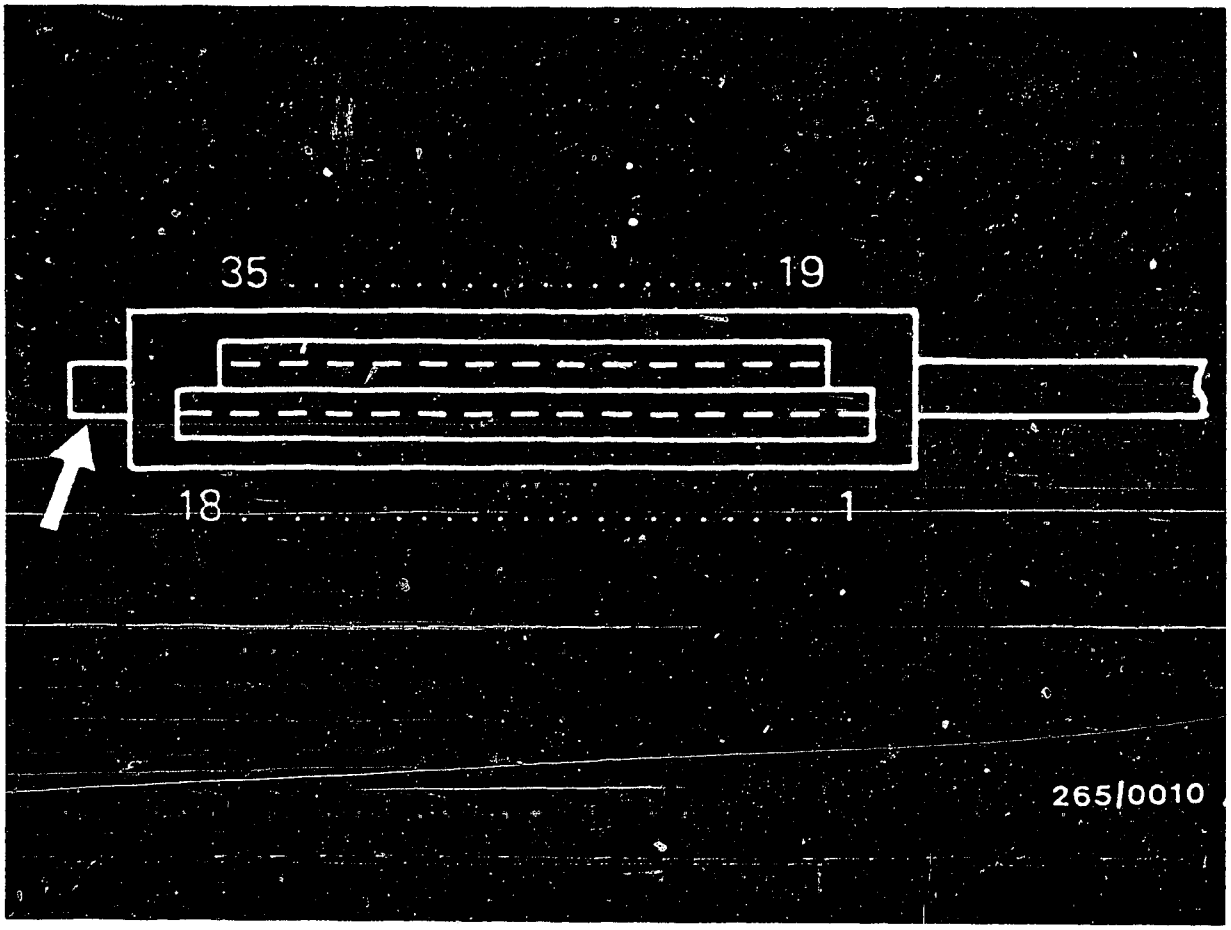
Continued on C 6



1 = Valve relay
2 = Motor relay

Top view of plug-in plate of hydraulic modulator.
Position of terminals:
VR = Valve relay
MR = Motor relay
K4 = Wiring-harness plug





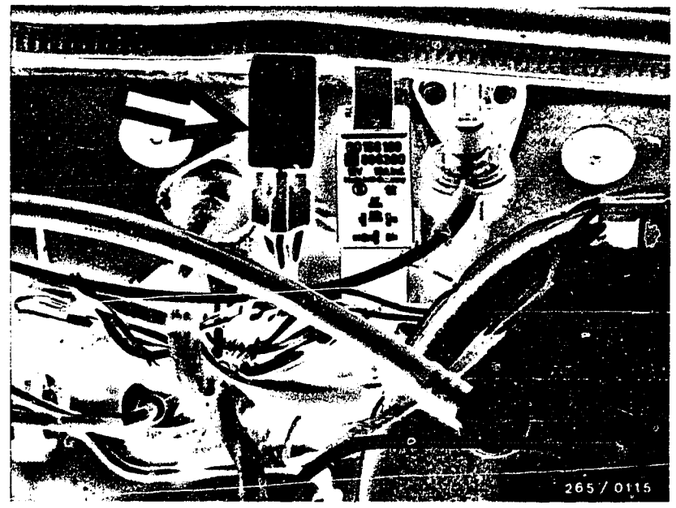
Trouble-shooting for TEST STEP 5 (continued)

Top view of multiple plug K 1 (35-pin) with terminal numbers.

Arrow = Lug with mechanical coding.

TEST STEP 6

Operation:		Reading:	Testing:
Program-selector switch position	5	Lamp 3 (green) must light up.	Component: Overvoltage protection relay
Additional operation 1. Switch off ignition; disconnect controller. 2. Using adapter cable, connect overvoltage-protection relay from vehicle in test plug on back of tester. 3. Connect new overvoltage-protection relay in vehicle and leave there. 4. Switch on ignition and wait approx. 1 s, then press illuminated key (lit). 5. Reading O.K.; overvoltage-protection relay in adapter cable O.K. 6. Re-connect controller; to do this, switch off ignition.			Operation: Built-in fuse and unindirectional-breakdown diode are tested.
		If reading O.K. continue testing with next test step.	Malfunction: Lamp 4 (red) lights up



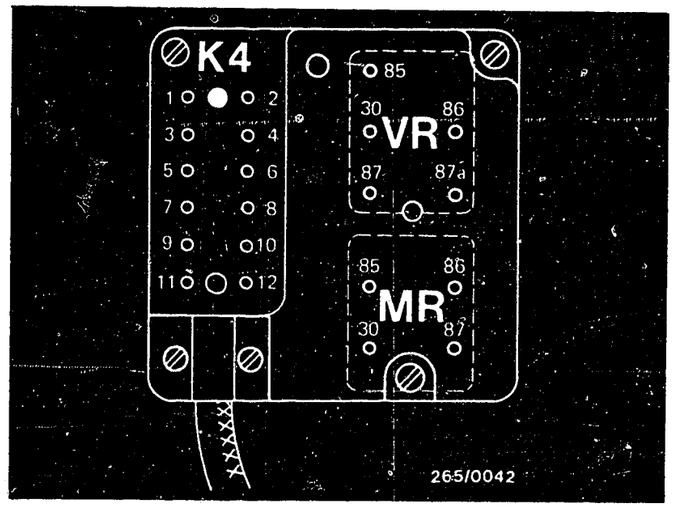
Arrow = Overvoltage protection relay

Trouble-shooting (switch off ignition):

1. Repeat test step.

2. The overvoltage-protection relay connected to the adapter cable is defective.

TEST STEP 7 Operation:		Reading:	Testing:
Program-selector switch position	6	Read off digital display unit each time after pressing a key.	Component: Hydraulic modulator
1. Press key FL	●	0.7 ... 1.7 Ω	Operation: Valve internal resistance FL
2. Press key FR	●	0.7 ... 1.7 Ω	Valve internal resistance FR
3. Press key RA	●	0.7 ... 1.7 Ω	Valve internal resistance RA
Operation in vehicle: Switch on ignition.		If reading OK, continue testing with next test step.	Malfunction: Internal resistance less than 0.7 Ω or greater than 1.7 Ω



Top view of plug-in plate of hydraulic modulator.
Position of terminals:
VR = Valve relay
MR = Motor relay
K4 = Wiring-harness plug

Top view of multiple plug K1 (35-pin) with terminal numbers
Arrow = Lug with mechanical encoding

Trouble-shooting (switch off ignition)

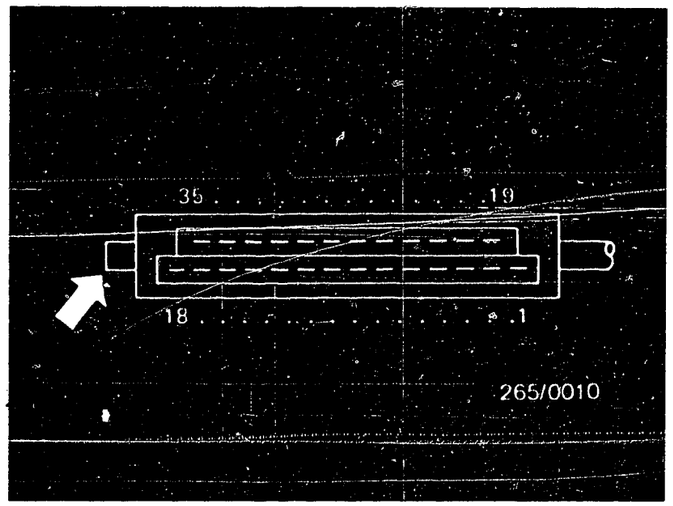
1. Measure internal restistance directly at hydraulic modulator:

Valve FL	between K4/term.3 and K4/term.4
Valve FR	between K4/term.1 and K4/term.4
Valve RA	between K4/term.5 and K4/term.4

Nominal value not reached:

Replace hydraulic modulator.

Continued on C11/C12



Trouble-shooting for TEST STEP 7 (continued)

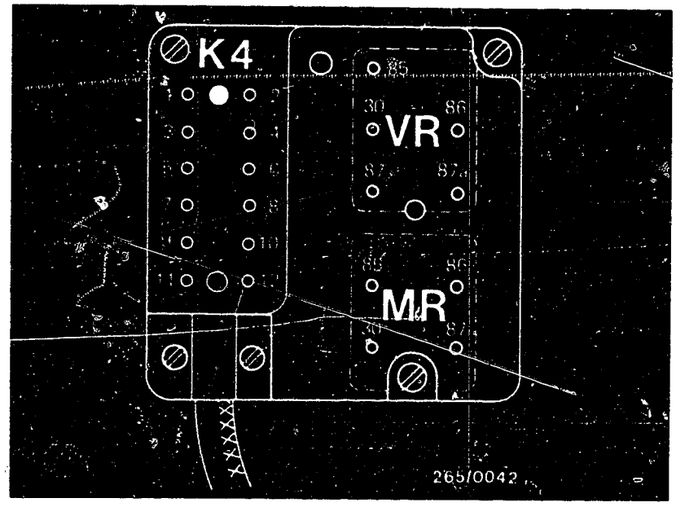
2. Test cables for continuity (set value 0 Ω)

Valve FL	between K3/term.3 and multiple plug K1/term.2
Valve FR	between K3/term.1 and multiple plug K1/term.35
Valve RA	between K3/term.5 and multiple plug K1/term.18

If open circuit:

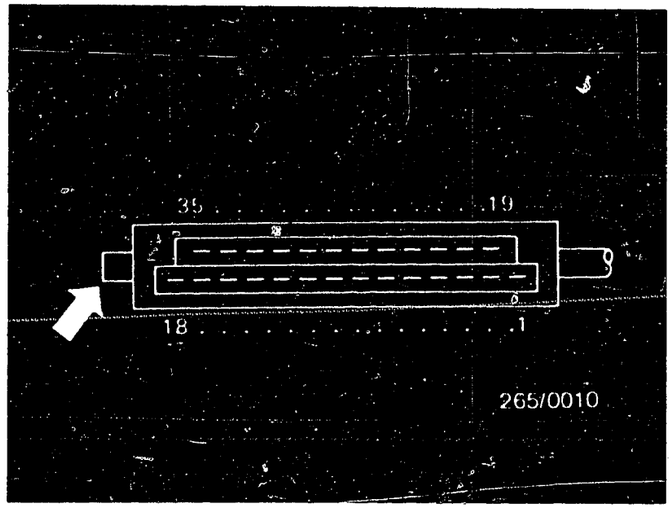
- Check plug-in connections
- Eliminate open circuit

Continued on C13/C14



Top view of plug-in plate of hydraulic modulator

VR = Valve relay
MR = Return-pump relay
K4 = Wiring harness plug



Top view of multiple plug K1 (35-pin) with terminal numbers
Arrow = Lug with mechanical encoding

Trouble-shooting for TEST STEP 7 (continued)

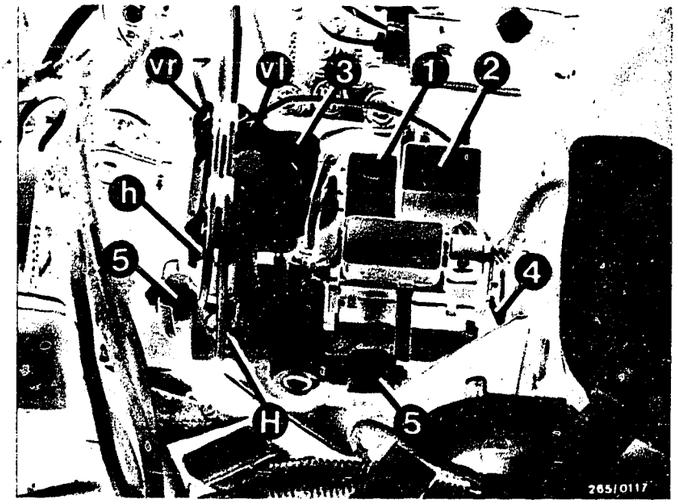
Removing the hydraulic modulator

- For safety reasons, the hydraulic modulator must not be repaired, but the complete unit must be replaced.
 Exceptions to this are the return-pump relay and the valve relay. Both relays may be replaced.

- Apart from the brake-line connections, no screws on the hydraulic modulator may be loosened or removed. Under no circumstances may the hexagon-socket-head cap screws (arrows) be loosened. After loosening, it is no longer possible to get the brake circuits leak-tight or the brake circuits can no longer be bled.
 Danger!

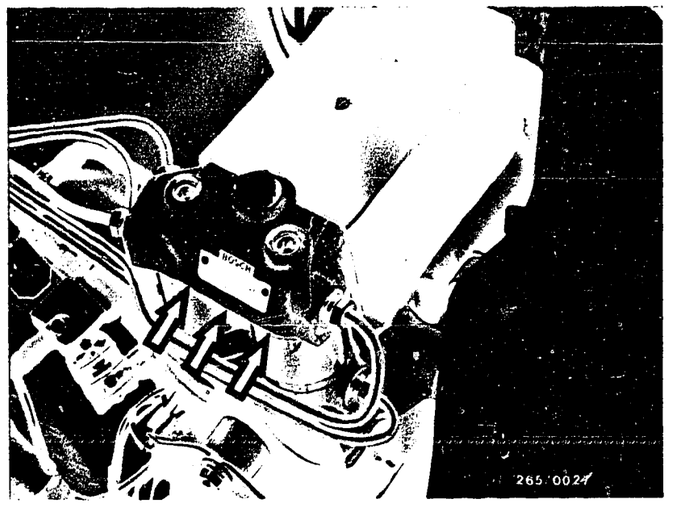
- Visually inspect hydraulic modulator and brake-line connections for leaks. Pay particular attention to the joints identified by arrows (bottom picture). If brake fluid is escaping, tighten the brake-line connections (12...16 Nm) or replace the hydraulic modulator.

Continued on C15/C16



1 = Valve relay
2 = Motor relay
3 = Hydraulic modulator
4 = Pump motor ground terminal
5 = Fastening screws

Arrows = Joints



Trouble-shooting - TEST STEP 7 (continued)

On the base of the hydraulic modulator there is a vent hole to the pump pistons. A slight escape of brake fluid is possible at this point.
A complaint is justified only if, after repeated operation of the brake pedal, there is a pool of brake fluid under the hydraulic modulator.

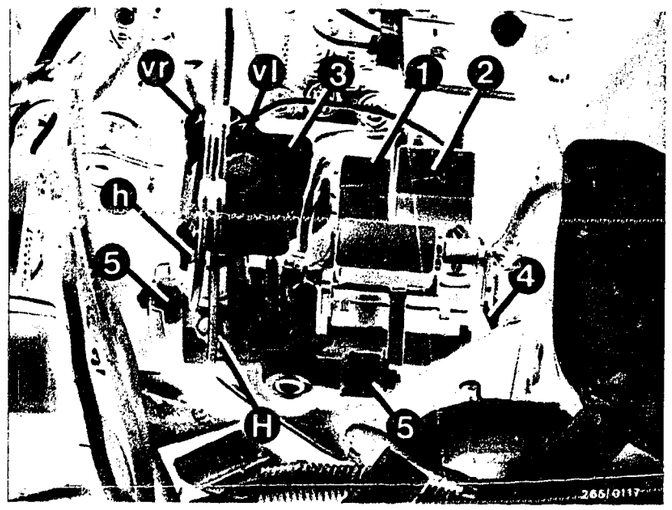
- When removing and installing the brake lines, make sure that the lines are marked in accordance with the markings on the hydraulic modulator and that they are not mixed up when re-connecting (e.g. FL of hydraulic modulator must be connected to the front left wheel brake cylinder).

- Markings on hydraulic modulator

VL = Connection for brake line front left (wheel brake cylinder)
VR = Connection for brake line front right (wheel brake cylinder)
HR = Connection for brake line rear right (wheel brake cylinder)

V = Front axle brake circuit from brake master cylinder
H = Rear axle brake circuit from brake master cylinder

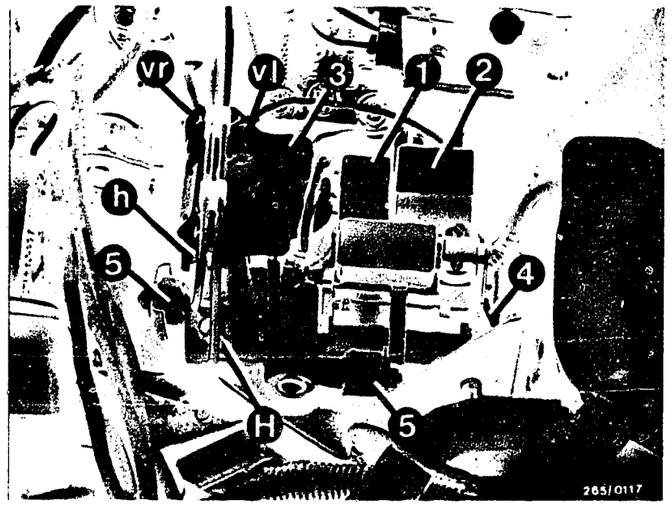
Continued on C17/C18



1 = Valve relay
2 = Motor relay
3 = Hydraulic modulator
4 = Pump motor ground terminal
5 = Fastening screws

Trouble-shooting for TEST STEP 7 (continued)

- Use only the specified double-end flare nut wrench 9x11 mm for loosening and tightening the brake lines.
- Mark brake lines and remove from hydraulic modulator.
- Catch the brake fluid and do not bring it into contact with your skin or clothing or with paintwork.
- Immediately seal the brake lines and connections with dummy plugs.
- Disconnect ground lead from pump motor.
- Loosen fastening screw and take off cover.
- Loosen bracket and take off the plug.
- Loosen hexagon nuts from holder and take off hydraulic modulator.



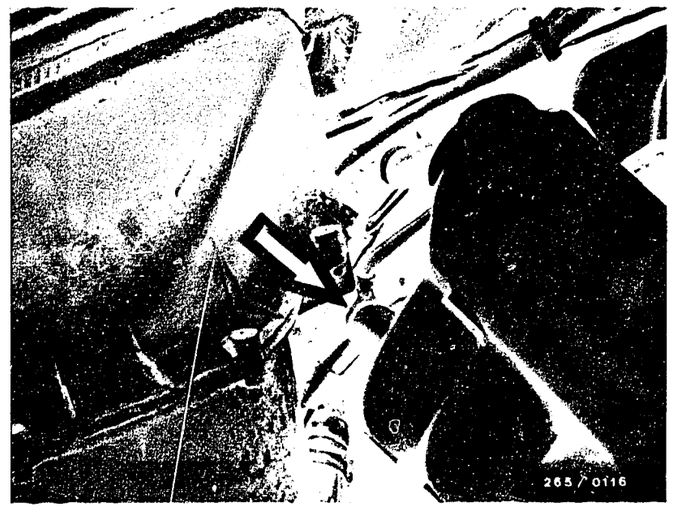
1 = Valve relay
2 = Motor relay
3 = Hydraulic modulator
4 = Pump motor ground terminal
5 = Fastening screws

Installation

- Mount hydraulic modulator in the holder and fasten with the hexagon nuts.
- Connect ground cable to pump motor. Plug on 12-pin plug and fasten with the bracket.
- Secure cover on hydraulic modulator with the screw.
- Connect the brake lines to the hydraulic modulator in accordance with the markings.
- Observe the tightening torque for the brake-line connections on the hydraulic modulator: 12...16 Nm.
- Bleed the brake system and check for leaks.
- Fully test the ABS with the tester.

TEST STEP 8

Operation:		Reading:	Testing:
Program-selector switch position	7	Digital display unit must indicate 60...300 mV.	Component: Ground connection term.10
Illuminated key lights up, press key	●	If reading OK, continue testing with next test step.	Operation: Contact resistance
Operation in vehicle: Switch on ignition			Malfunction: Reading less than 60 mV or greater than 300 mV

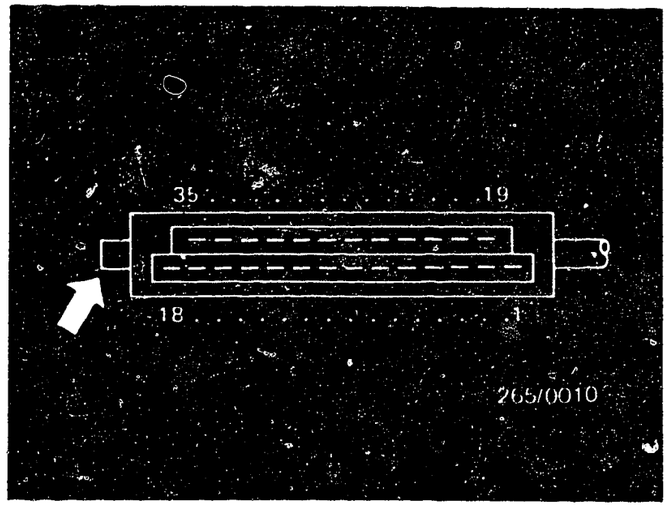


Arrow = Ground terminal for ABS and LE-Jetronic

Trouble-shooting (switch off ignition):

1. Reading less than 60 mV: Have tester checked.
2. Reading greater than 300 mV: Check ground terminal on intake port (cylinder 6) as well as ground strap between engine block and vehicle frame for security, high contact resistance and open circuit. Check ground lead from multiple plug K1/ term. 10 through overvoltage-protection relay term. 31b and term. 31 to ground terminal for contact resistance and open circuit.

Top view of multiple plug K1 (35-pin) with terminal numbers
Arrow = Lug with mechanical encoding



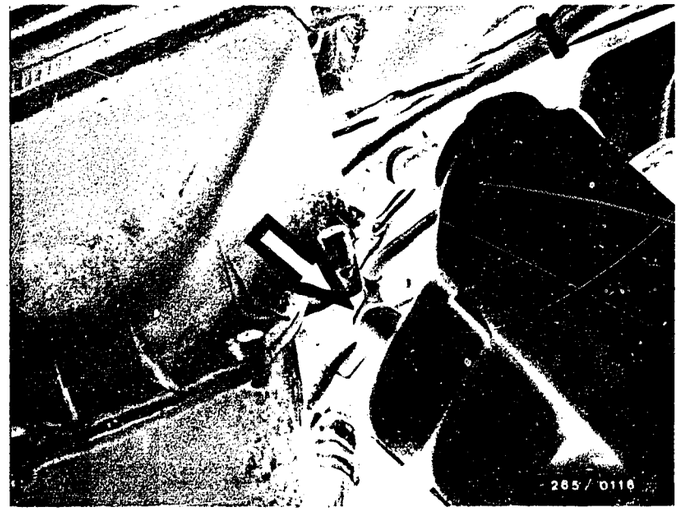
TEST STEP 9

Operation:		Reading:	Testing:
Program-selector switch position	8	Digital display unit must indicate 10 ... 250 mV	Component: Ground connection term. 34
Illuminated key lights up, press key	●		Operation: Contact resistance
Operation in vehicle: Switch on ignition		If reading O.K., continue testing with next test step.	Malfunction: Reading less than 10 mV or greater than 250 mV

Trouble-shooting (switch off ignition):

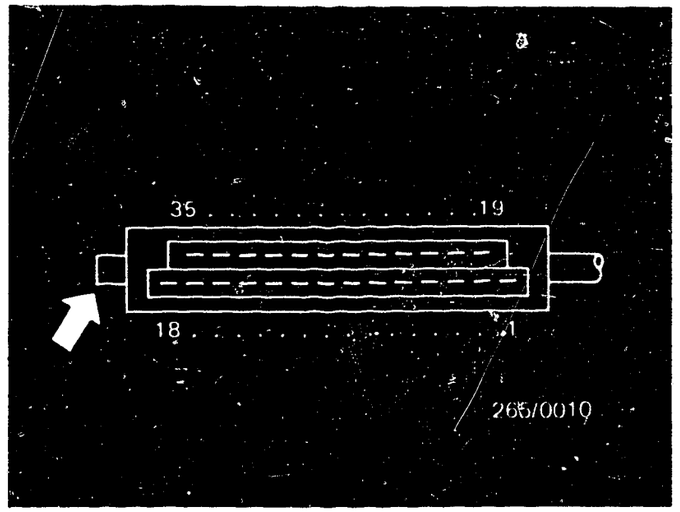
1. Reading less than 10 mV: Have the tester checked.

2. Reading greater than 250 mV: Check ground terminal on intake port (cylinder 6) as well as ground strap between engine block and vehicle frame for security, high contact resistance and open circuit:
Check lead for open circuit:
From ground to multiple plug K1/term. 34.



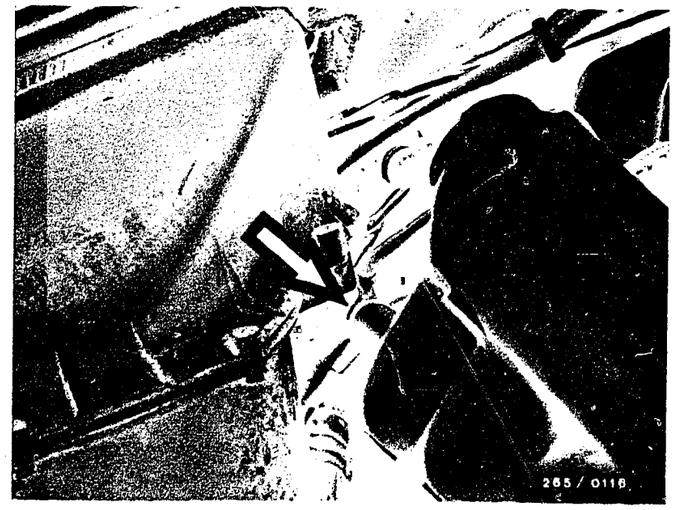
Arrow = Ground terminal for ABS and LE-Jetronic

Top view of multiple plug K1 (35-pin) with terminal numbers
Arrow = Lug with mechanical encoding



TEST STEP 10

Operation:		Reading:	Testing:
Program-selector switch position	9	Digital display unit must indicate 10 ... 250 mV	Component: Ground connection term. 20
Illuminated key lights up, press key	●		Operation: Contact resistance
Operation in vehicle: Switch on ignition		If reading O.K., continue testing with next test step.	Malfunction: Reading less than 10 mV or greater than 250 mV



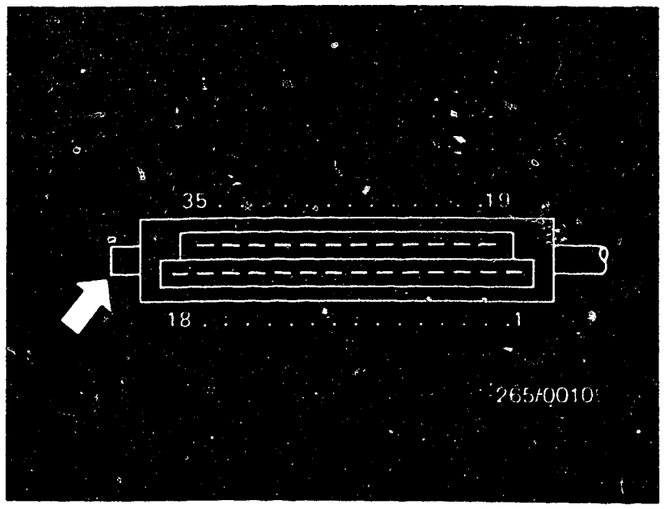
Arrow = Ground terminal for ABS and LE-Jetronic

Top view of multiple plug K1 (35-pin) with terminal numbers
Arrow = Lug with mechanical encoding

Trouble-shooting (switch off ignition):

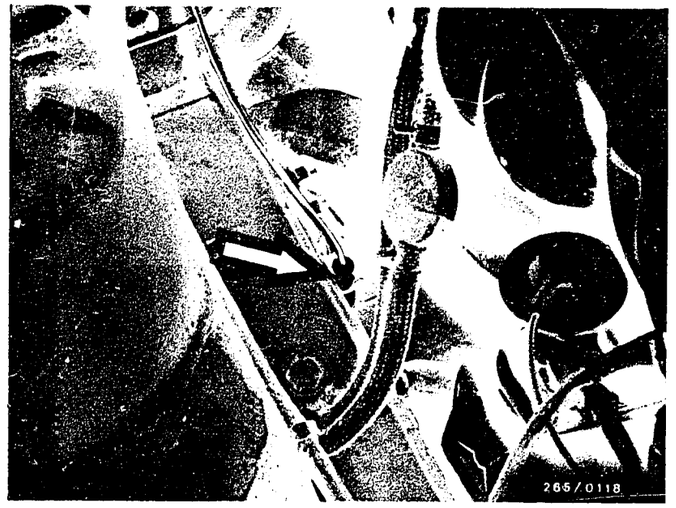
1. Reading less than 10 mV: Have the tester checked.

2. Reading greater than 250 mV: Check ground terminal on intake port (cylinder 6) as well as ground strap between engine block and vehicle frame for security, high contact resistance and open circuit:
Check lead for open circuit:
From ground to multiple plug K1/term. 20.



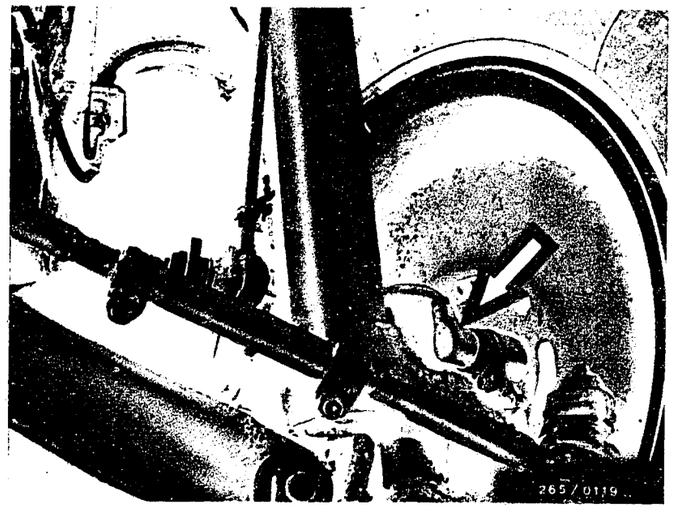
TEST STEP 11

Operation:		Reading:	Testing:
Program-selector switch position	10	Digital display unit: for FL and FR: 0,6 ... 1,6 kΩ [1]	Component: Wheel-speed sensors front left and front right
Press keys FL and FR one after the other	●	If reading O.K., continue testing with next test step.	Operation: Internal resistance
Operation in vehicle: Switch on ignition			Malfunction: Reading less than 0,6 kΩ or greater than 1,6 kΩ



Arrow = Wheel-speed sensor plug connector

Arrow = Wheel-speed sensor



Note: [1]
If a vehicle is brought in with the complaint "warning lamp lighting up occasionally, but after starting again warning lamp stays off" the cause may be a loose contact in the wheel-speed leads or in the plug-in connectors of the wheel-speed sensor. The cause will be a temporary open circuit or contacting of wires which is caused by vibrations or changes in load.

Locate the fault using the following method.

Continued on D 3/D 4

Note on TEST STEP 11 (continued)

Method of testing for loose contacts with wheel-speed sensors:

- One after the other, select wheel-speed sensors by pressing key.
- On the wheel-speed sensor which has been selected, move the corresponding cable directly at the wheel-speed sensor and at the fastening points and also move the plug-in connections, also bend and pull.
- At the same time watch the digital display on the tester:
 If there is a sharp change in the digital reading, there is a loose contact. In the case of an open circuit the reading becomes greater (max. 999), in the case of a short circuit (usually at the wiring-harness plug) the reading becomes smaller (min. 000).
- Replace wheel-speed sensor.
- Replace wiring harness or use repair kit (e.g. from Audi).

Trouble-shooting (switch off ignition)

1. Measure internal resistance at disconnected connectors.

If the set value is not reached: Replace the corresponding wheel-speed sensor.

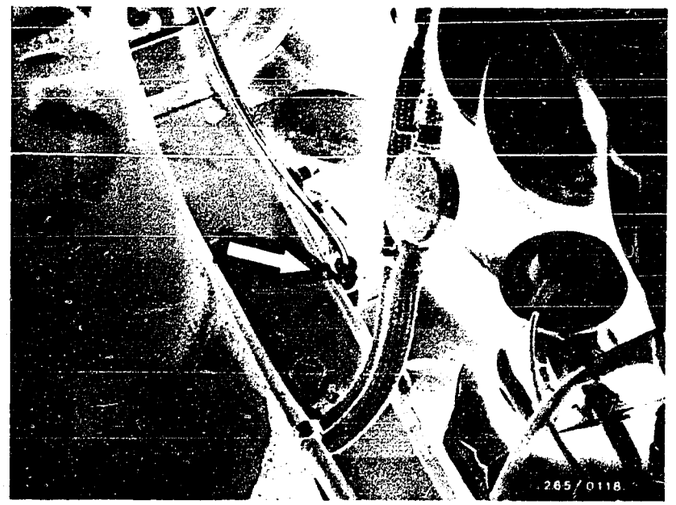
2. Test the following leads for continuity.
From plug K 11 to multiple plug K1/term. 6 and term. 4.
From plug K 13 to multiple plug K1/term. 11 and term. 21.

3. Check plug-in connections.

Removing front-axle wheel-speed sensors

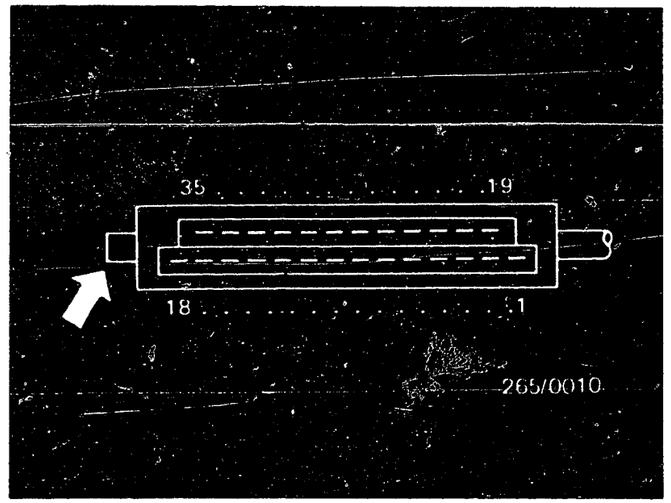
- The plug connectors are on the respective frame side member.
- Take plug connector out of holder and take apart.
- Remove wheel-speed sensor lead from fastening clamps.
- Loosen fastening screw for wheel-speed sensor and carefully take out wheel-speed sensor. Do not use force.

Continued on D5/D6



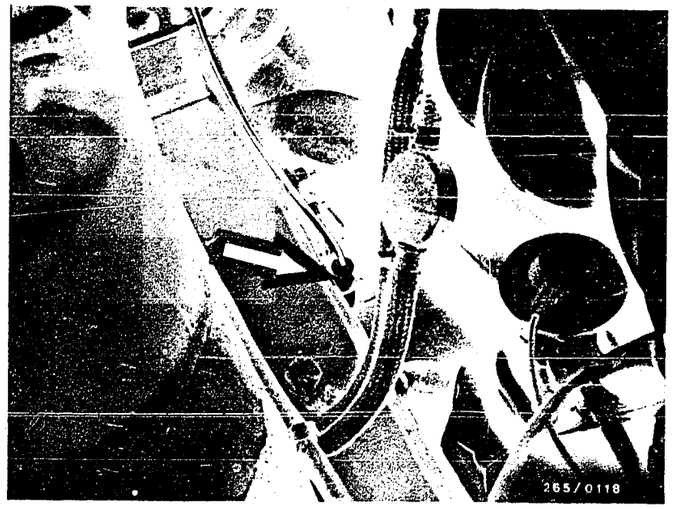
1 = Wheel-speed sensor plug-in connector

Top view of multiple plug K1 (35-pin) with terminal numbers.
Arrow = Lug with mechanical encoding



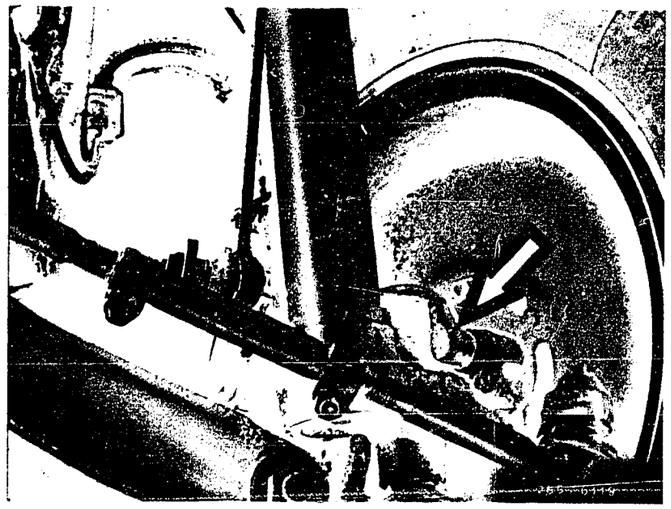
Install wheel-speed sensor on front axle.

- Check O-ring for cracks and replace if necessary.
- Only take new wheel-speed sensor out of protective sleeve when ready for mounting.
- Grease wheel-speed sensor housing lightly with Molykote Longterm 2.
- Make sure that no metallic foreign bodies are on the permanently magnetic edge.
- Carefully press wheel-speed sensor into mounting hole as far as it will go. Do not knock.
- Use new micro-encapsulated fastening screws.
 Tighten fastening screws to min. 8 Nm.
- Re-secure lead at the intended places.
- Connect wheel-speed sensor to ABS wiring harness and clip plug connector into holder.
- After repairing, test with ABS tester.

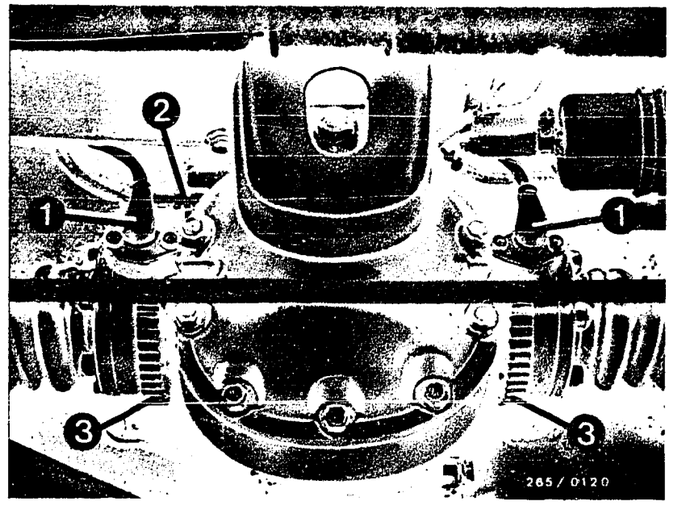


1 = Wheel-speed sensor plug-in connector

Arrow = Wheel-speed sensor



TEST STEP 12			
Operation:		Reading:	Testing:
Program-selector switch position	10	Digital display unit must indicate 0,6 ... 1,6 kΩ [1)]	Component: Wheel-speed sensor for rear axle
Press keys RL and RR on after the other	●		Operation: Internal resistance
Operation in vehicle: Switch on ignition		If reading O.K., continue testing with next test step.	Malfunction: Reading less than 0,6 kΩ or greater than 1,6 kΩ



1 = Wheel-speed sensor
2 = Wheel-speed sensor plug connector
3 = Ring gear

Note: [1)]
If a vehicle is brought in with the complaint "warning lamp lighting up occasionally, but after starting again warning lamp stays off" the cause may be a loose contact in the wheel-speed leads or in the plug-in connectors of the wheel-speed sensor. The cause will be a temporary open circuit or contacting of wires which is caused by vibrations or changes in load.

Locate the fault using the following method.

Continued on D 9/D 10

Note - TEST STEP 12 (continued)

Method of testing for loose contacts with wheel-speed sensor:

- Select wheel-speed sensor by pressing key.
- On the wheel-speed sensor which has been selected, move the corresponding cable directly at the wheel-speed sensor and at the fastening points and also move the plug-in connections, also bend and pull.
- At the same time watch the digital display on the tester:
 If there is a sharp change in the digital reading, there is a loose contact. In the case of an open circuit the reading becomes greater (max. 999), in the case of a short circuit (usually at the wiring-harness plug) the reading becomes smaller (min. 000).
- Replace wheel-speed sensor.
- Replace wiring harness or use repair kit (e.g. from Audi).

Trouble-shooting (switch off ignition)

1. Measure internal resistance at disconnected connectors.

If the set value is not reached: Replace the corresponding wheel-speed sensor.

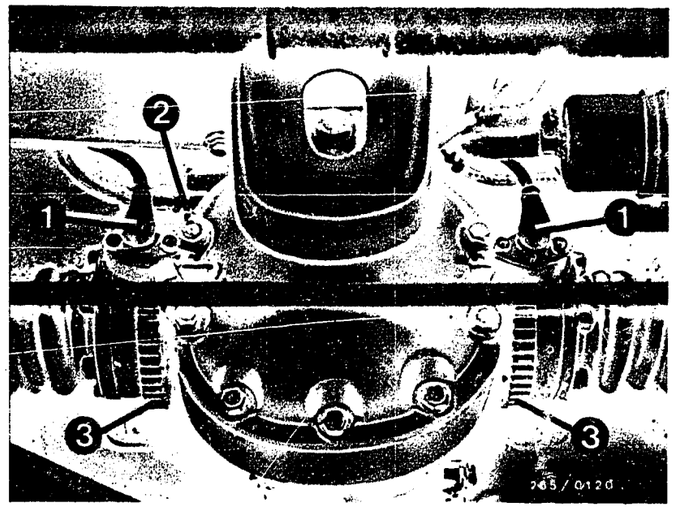
2. Test the following leads for continuity.
From plug K 15 to multiple plug K1/term. 8 and term. 9.
From plug K 17 to multiple plug K1/term. 24 and term. 26.

3. Check plug-in connections.

Removing rear-axle wheel-speed sensors

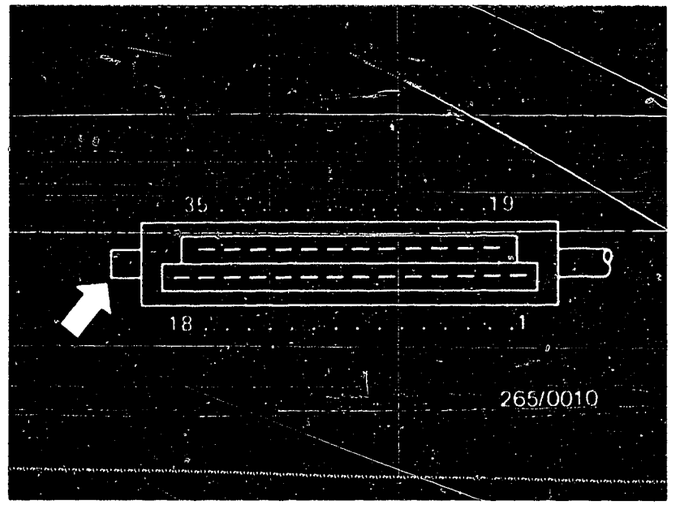
- Take plug connector out of holder and take apart.
- Take wheel-speed sensor lead out of fastening clamps.
- Loosen fastening screws for wheel-speed sensor. Do not unscrew the holding bracket. Pull out wheel-speed sensor. Do not use force. Do not lose shims.

Continued on D11/D12



1 = Wheel-speed sensor
2 = Wheel-speed sensor plug connector
3 = Ring gear

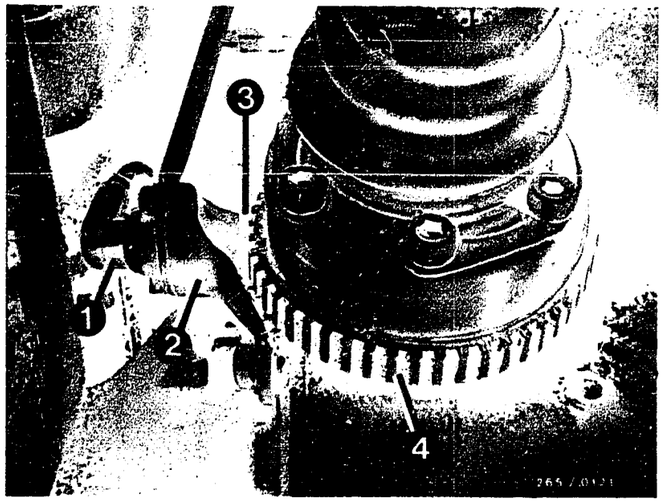
Top view of multiple plug K1 (35-pin) with terminal numbers.
Arrow = Lug with mechanical encoding



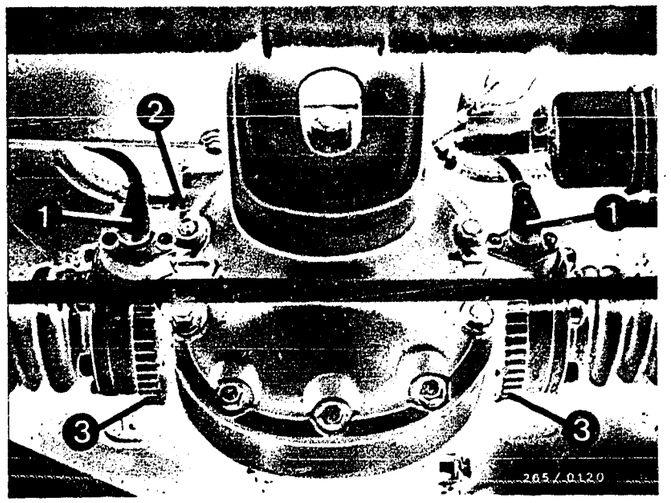
Trouble-shooting for TEST STEP 12 (continued)

Installing the wheel-speed sensors on the rear axle

- Check O-ring for cracks and replace if necessary.
- Only take new wheel-speed sensor out of protective sleeve when ready for mounting.
- Grease wheel-speed sensor housing lightly with Molykote Longterm 2. Mount shim(s).
- Make sure that no metallic foreign bodies are on the permanently magnetic edge.
- Carefully press wheel-speed sensor into mounting hole as far as it will go. Do not knock.
- Measure air gap between wheel-speed sensor edge and ring gear with feeler gauge. Gap should be 0.3...1.0 mm. If necessary, correct air gap with shims.
- Use new micro-encapsulated fastening screws. Tighten fastening screws to min. 8 Nm.
- Re-secure lead at the intended places.
- Connect wheel-speed sensor to ABS wiring harness and clip plug connector into holder.
- After repairing, test with ABS tester.



1 = Wheel-speed sensor
2 = Holding bracket
3 = Air gap
4 = Ring gear



1 = Wheel-speed sensor
2 = Wheel-speed sensor plug connector
3 = Ring gear

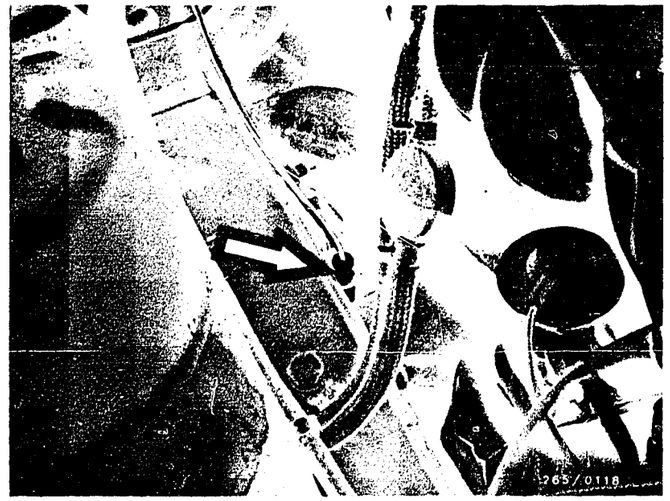
TEST STEP 13

Operation:		Reading:	Testing:
Program-selector switch position	11	Digital display unit: for FL and FR: 20 ... 999 kΩ	Component: Wheel-speed sensors front left and front right
Press keys FL and FR one after the other	●	If reading O.K., continue testing with next test step.	Operation: Insulation resistance
Operation in vehicle: Switch on ignition			Malfunction: Reading less than 20 kΩ

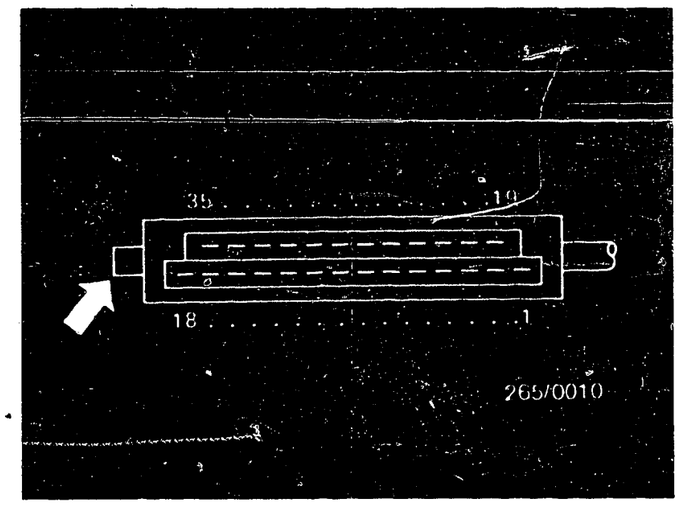
Trouble-shooting (switch off ignition):

Plug connectors OK?
Undo plug connectors and bridge the plug leading to the tester using wire.
Repeat test:
If reading now OK, replace wheel-speed sensor.
If reading still below the nominal value, the cables from multiple plug term.6 and term.4 or term.11 and term.21 to the respective plug are defective.
Check all cables for wear and short circuit to ground.

Continued on D15/D16



1 = Wheel-speed sensor plug-in connector



Top view of multiple plug K1 (35-pin) with terminal numbers
Arrow = Lug with mechanical encoding

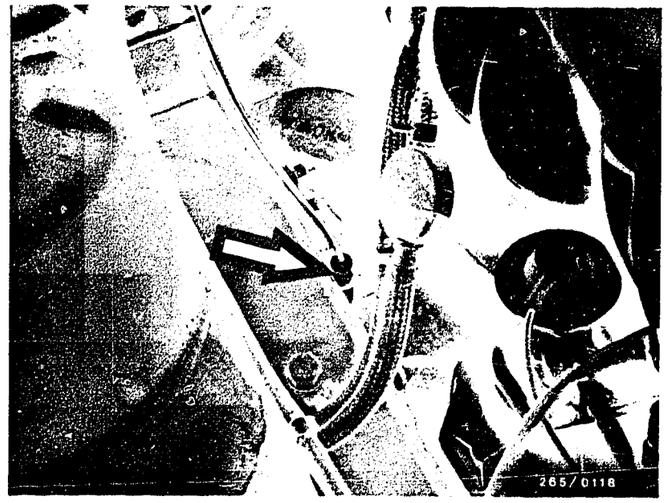
Trouble-shooting for TEST STEP 13 (continued)

Removing front-axle wheel-speed sensors

- The plug connectors are on the respective frame side member.
- Take plug connector out of holder and take apart.
- Remove wheel-speed sensor lead from fastening clamps.
- Loosen fastening screw for wheel-speed sensor and carefully take out wheel-speed sensor. Do not use force.

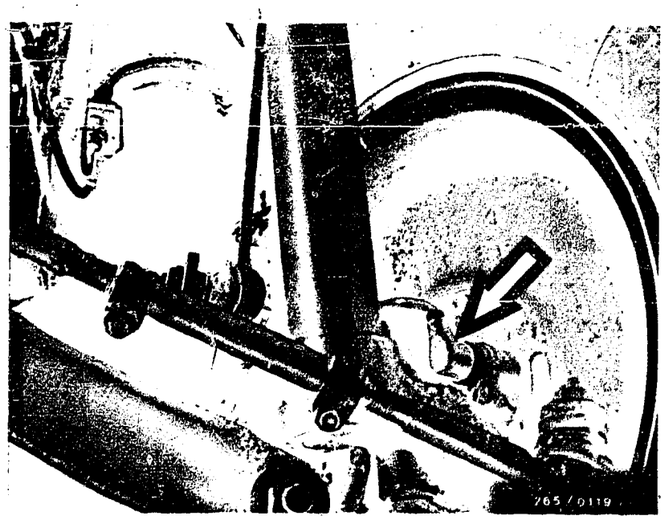
Install wheel-speed sensor on front axle.

- Check O-ring for cracks and replace if necessary.
- Only take new wheel-speed sensor out of protective sleeve when ready for mounting.
- Grease wheel-speed sensor housing lightly with Molykote Longterm 2.
- Make sure that no metallic foreign bodies are on the permanently magnetic edge.
- Carefully press wheel-speed sensor into mounting hole as far as it will go. Do not knock.
- Use new micro-encapsulated fastening screws.
 Tighten fastening screws to 8 Nm.
- Re-secure lead at the intended places.
- Connect wheel-speed sensor to ABS wiring harness and clip plug connector into holder.
- After repairing, test with ABS tester.



1 = Wheel-speed sensor plug-in connector

Arrow = Wheel-speed sensor



TEST STEP 14

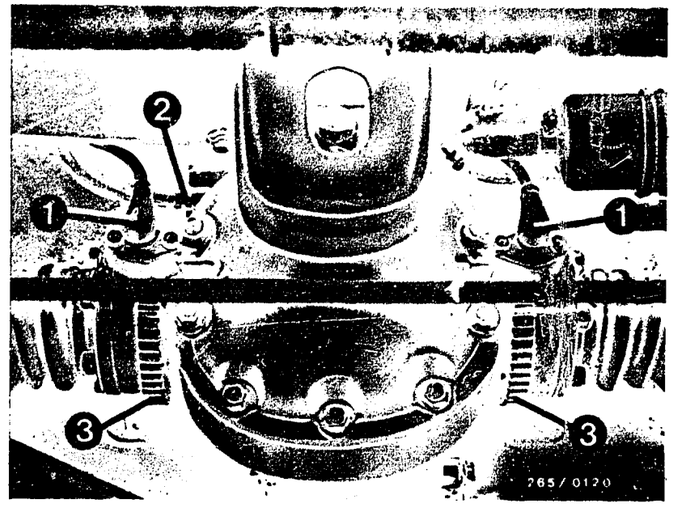
Operation:		Reading:	Testing:
Program-selector switch position	11	Digital display unit: 20 ... 999 kΩ	Component: Wheel-speed sensors rear left and rear right
Press keys RL and RR one after the other.	●		Operation: Insulation resistance
Operation in vehicle: Switch on ignition		If reading O.K., continue testing with next test step.	Malfunction: Reading less than 20 kΩ

Trouble-shooting (switch off ignition)

Plug-in connection O.K.?
Take apart plug-in connectors and, using wire, jump the plug leading to the tester.
Repeat test: If reading now O.K., replace wheel speed sensor. If the reading is still less than the set value, the leads from the multiple plug term. 8 and term. 9 or term. 24 and term. 26 to the respective connector are defective.

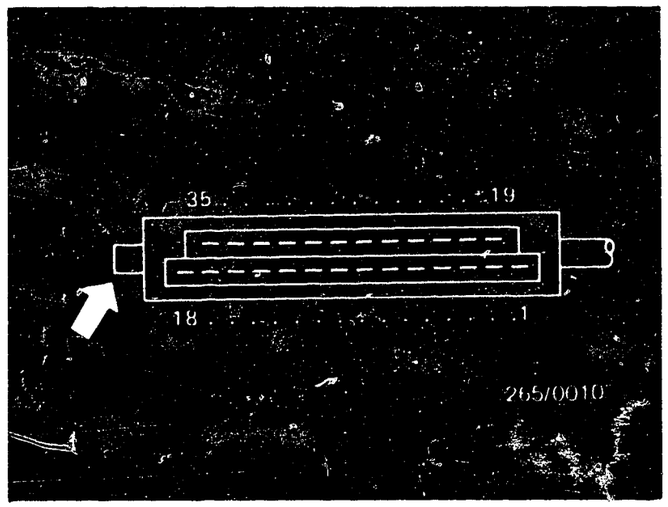
Check all cables for wear and short circuit to ground

Continued on D19/D20



1 = Wheel-speed sensor
2 = Wheel-speed sensor plug connector
3 = Ring gear

Top view of multiple plug K1 (35-pin) with terminal numbers.
Arrow = Lug with mechanical encoding



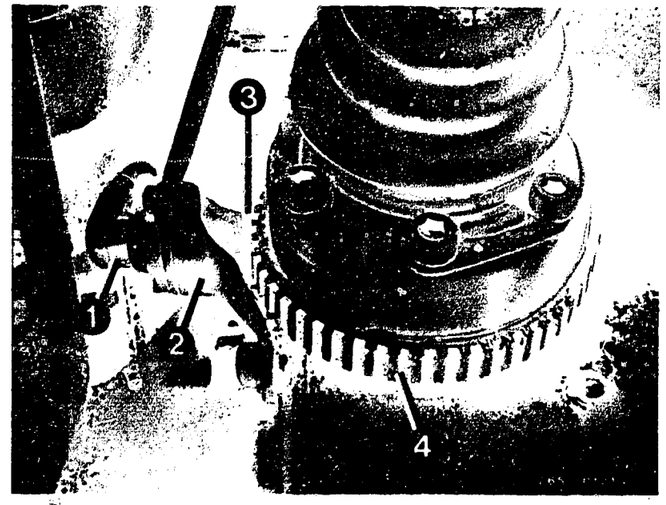
Trouble-shooting for TEST STEP 14 (continued)

Removing rear-axle wheel-speed sensors

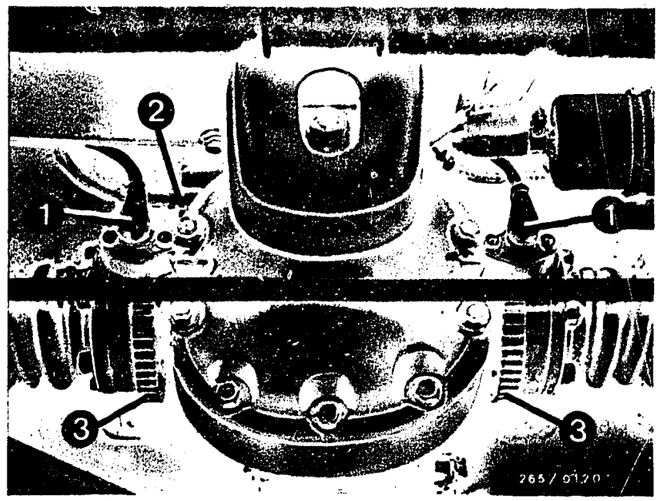
- Take plug connector out of holder and take apart.
- Take wheel-speed sensor lead out of fastening clamps.
- Loosen fastening screws for wheel-speed sensor. Do not unscrew the holding bracket. Pull out wheel-speed sensor. Do not use force. Do not lose shims.

Installing the wheel-speed sensors on the rear axle

- Check O-ring for cracks and replace if necessary.
- Only take new wheel-speed sensor out of protective sleeve when ready for mounting.
- Grease wheel-speed sensor housing lightly with Molykote Longterm 2. Mount shim(s).
- Make sure that no metallic foreign bodies are on the permanently magnetic edge.
- Carefully press wheel-speed sensor into mounting hole as far as it will go. Do not knock.
- Measure air gap between wheel-speed sensor edge and ring gear with feeler gauge. Gap should be 0.3...1.0 mm. If necessary, correct air gap with shims.
- Use new micro-encapsulated fastening screws. Tighten fastening screws to min. 8 Nm.
- Re-secure lead at the intended places.
- Connect wheel-speed sensor to ABS wiring harness and clip plug connector into holder.
- After repairing, test with ABS tester.



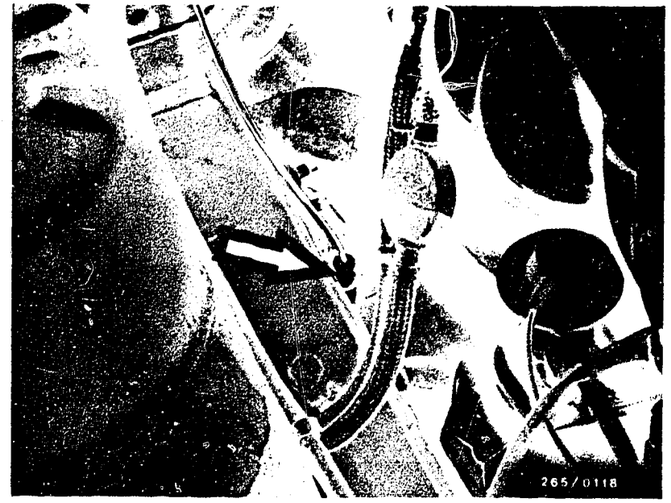
1 = Wheel-speed sensor
2 = Holding bracket
3 = Air gap
4 = Ring gear



1 = Wheel-speed sensor
2 = Wheel-speed sensor plug connector
3 = Ring gear

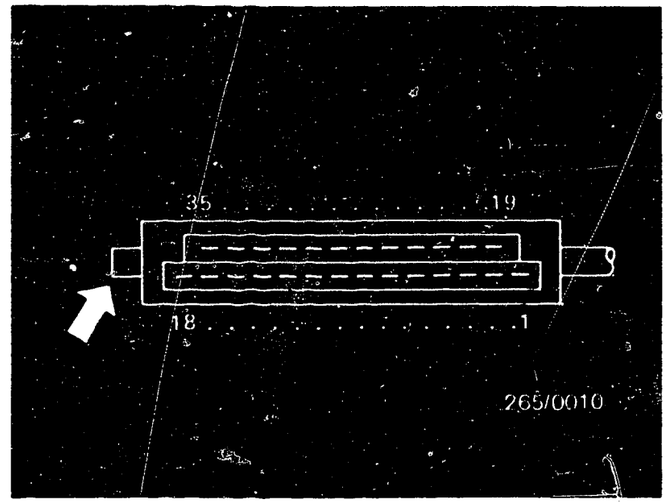
TEST STEP 15

Operation:		Reading:	Testing:
Program-selector switch position	12	Digital display unit: for FL and FR: 0 ... 100 mV	Component: Wheel-speed sensors front left and front right
Press keys FL and FR one after the other	●	If reading O.K., continue testing with next test step.	Operation: DC voltage on cable
Operation in vehicle: Switch on ignition			Malfunction: Reading greater than 100 mV



Arrow = Wheel-speed sensor plug connector

Top view of multiple plug K1 (35-pin) with terminal numbers
Arrow = Lug with mechanical plug



Trouble-shooting (switch off ignition)

Plug-in connection O.K.?
Undo plug connector and bridge the connector leading to the tester with a lead.
Repeat test: If reading is now O.K., replace wheel-speed sensor.
If reading is still under the set value, the leads from multiple plug term. 6 and term. 4 or term. 11 and 21 to the plug are defective.

Check all cables for wear and short circuit to ground.

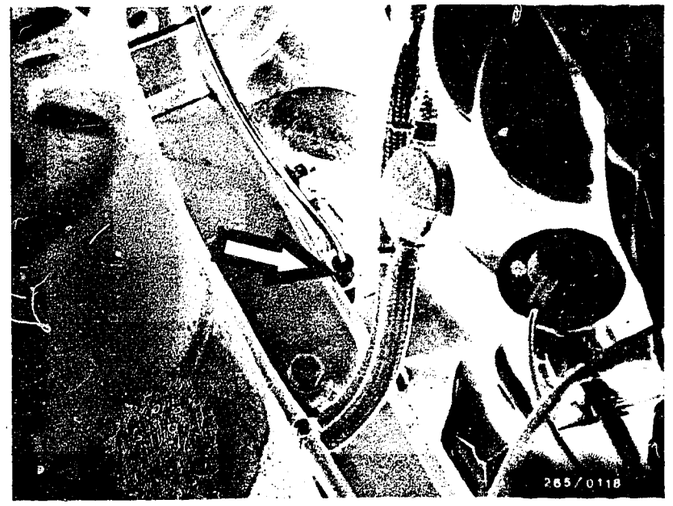
Continued on D23/D24

Removing front-axle wheel-speed sensors

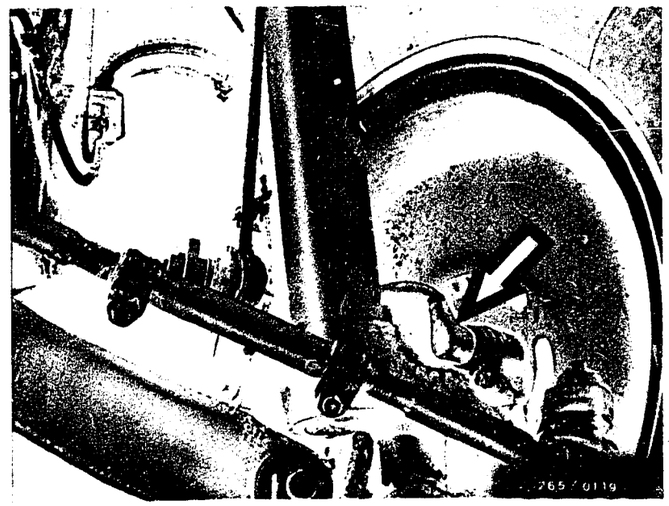
- The plug connectors are on the respective frame side member.
- Take plug connector out of holder and take apart.
- Remove wheel-speed sensor lead from fastening clamps.
- Loosen fastening screw for wheel-speed sensor and carefully take out wheel-speed sensor. Do not use force.

Install wheel-speed sensor on front axle.

- Check O-ring for cracks and replace if necessary.
- Only take new wheel-speed sensor out of protective sleeve when ready for mounting.
- Grease wheel-speed sensor housing lightly with Molykote Longterm 2.
- Make sure that no metallic foreign bodies are on the permanently magnetic edge.
- Carefully press wheel-speed sensor into mounting hole as far as it will go. Do not knock.
- Use new micro-encapsulated fastening screws.
 Tighten fastening screws to 8 Nm.
- Re-secure lead at the intended places.
- Connect wheel-speed sensor to ABS wiring harness and clip plug connector into holder.
- After repairing, test with ABS tester.



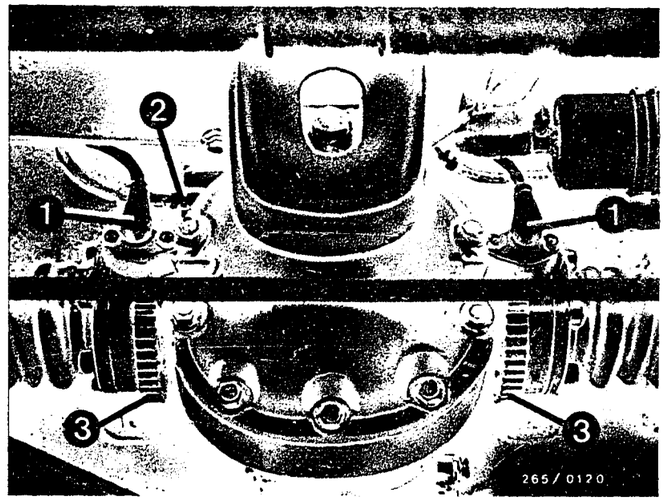
1 = Wheel-speed sensor plug-in connector



Arrow = Wheel-speed sensor

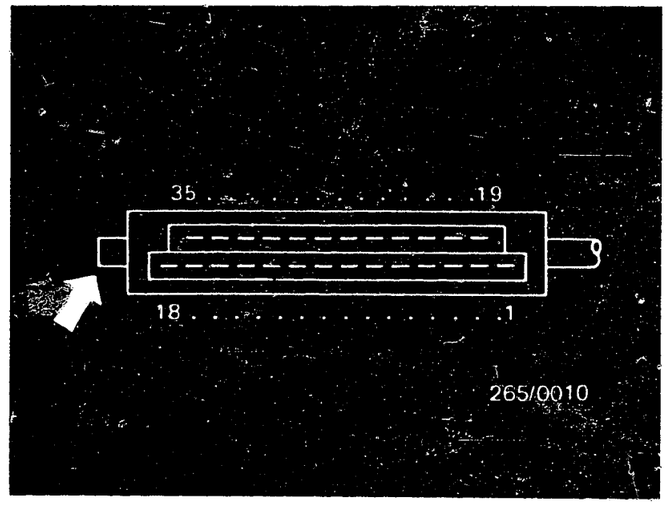
TEST STEP 16

Operation:		Reading:	Testing:
Program-selector switch position	12	Digital display unit: 0 ... 100 mV	Component: Wheel-speed sensors rear left and rear right
Press keys RL and RR one after the other.	●		Operation: DC voltage on line
Operation in vehicle: Switch on ignition		If reading O.K., continue testing with next test step.	Malfunction: Reading greater than 100 mV



1 = Wheel-speed sensor
2 = Wheel-speed sensor plug connector
3 = Ring gear

Top view of multiple plug K1 (35-pin) with terminal numbers.
Arrow = Lug with mechanical encoding



Trouble-shooting (switch off ignition)

Plug-in connection O.K.?
Take apart plug-in connectors and, using wire, jump the plug leading to the tester.
Repeat test: If reading now O.K., replace wheel speed sensor. If the reading is still less than the set value, the leads from the multiple plug term. 8 and term. 9 or term. 24 and term. 26 to the respective connector are defective.

Check all cables for wear and short circuit to ground

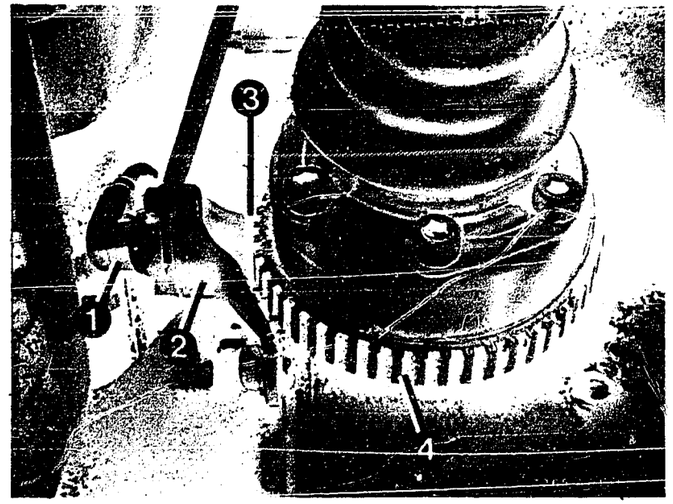
Continued on E3/E4

Removing rear-axle wheel-speed sensors

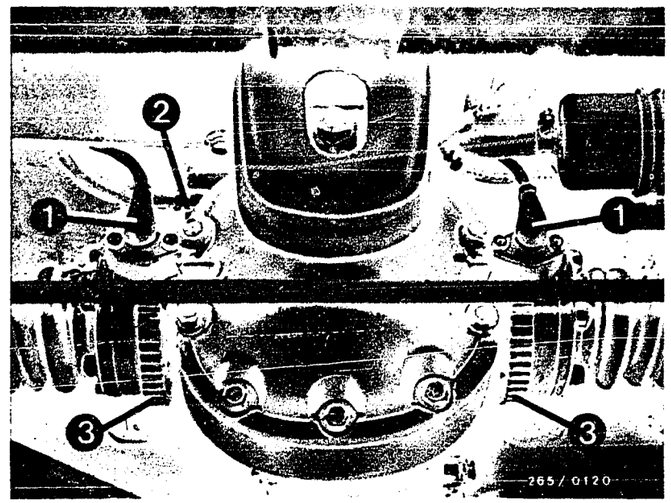
- Take plug connector out of holder and take apart.
- Take wheel-speed sensor lead out of fastening clamps.
- Loosen fastening screws for wheel-speed sensor. Do not unscrew the holding bracket. Pull out wheel-speed sensor. Do not use force.
- Loosen fastening screws and pull out wheel-speed sensor. Do not use force.

Installing the wheel-speed sensors on the rear axle

- Check O-ring for cracks and replace if necessary.
- Only take new wheel-speed sensor out of protective sleeve when ready for mounting.
- Grease wheel-speed sensor housing lightly with Molykote Longterm 2. Mount shim(s).
- Make sure that no metallic foreign bodies are on the permanently magnetic edge.
- Carefully press wheel-speed sensor into mounting hole as far as it will go. Do not knock.
- Measure air gap between wheel-speed sensor edge and ring gear with feeler gauge. Gap should be 0.3...1.0 mm. If necessary, correct air gap with shims.
- Use new micro-encapsulated fastening screws. Tighten fastening screws to min. 8 Nm.
- Re-secure lead at the intended places.
- Connect wheel-speed sensor to ABS wiring harness and clip plug connector into holder.
- After repairing, test with ABS tester.



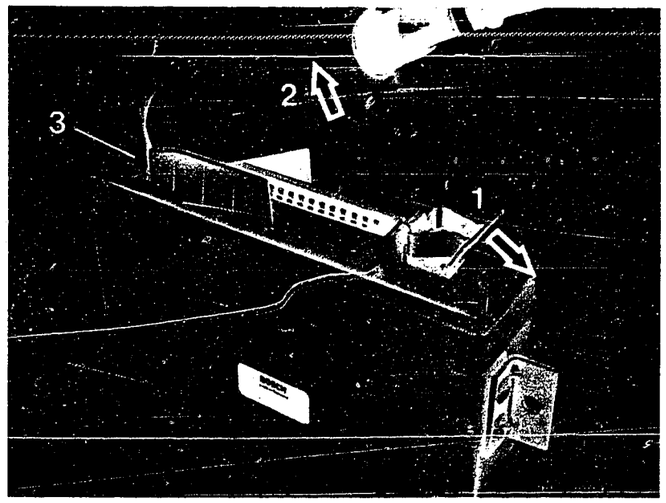
1 = Wheel-speed sensor
2 = Holding bracket
3 = Air gap
4 = Ring gear



1 = Wheel-speed sensor
2 = Wheel-speed sensor plug connector

TEST STEP 17

Operation:		Reading:	Testing:
Program-selector switch position	13	Digital display unit: 4.75 ... 5.25 V	Component: Controller
Illuminated key lights up, press key	●		Operation: Internal supply voltage
Operation in vehicle: Switch on ignition		If reading O.K., continue testing with next test step.	Malfunction: Voltage less than 4.7 V or greater than 5.25 V



1 = Spring
2 = Multiple plug (35-pin)
3 = Encoding block

Trouble-shooting:
Replace controller (switch off ignition).

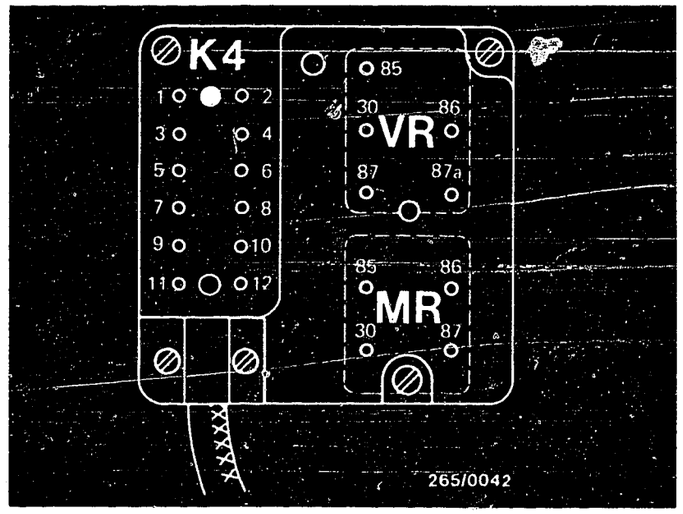
Notes:

- Switch off ignition before disconnecting multiple plug.
- To disconnect multiple plug, press back spring, hinge up multiple plug and unhook from encoding block.
- Install only the specified controller.
- When installing, make sure that multiple plug locks into spring.

Continued on E7/E8

TEST STEP 18

Operation:		Reading:	Testing:
Program-selector switch position	14	Digital display unit must indicate 0.4 ... 1.5 V Check: ABS indicator lamp in vehicle must light up. If reading O.K., continue testing with next test step.	Component: Hydraulic modulator and indicator lamp Operation: Diode in forward direction Malfunction: Reading less than 0.4 or greater than 1.5 V. Indicator lamp does not light up.
Operation in vehicle: Switch on ignition			



Top view of plug-in plate of hydraulic modulator.
Position of terminals:
VR = Valve relay
MR = Motor relay
K4 = Wiring-harness plug

Trouble-shooting (switch off ignition)

Indicator lamp not lit:

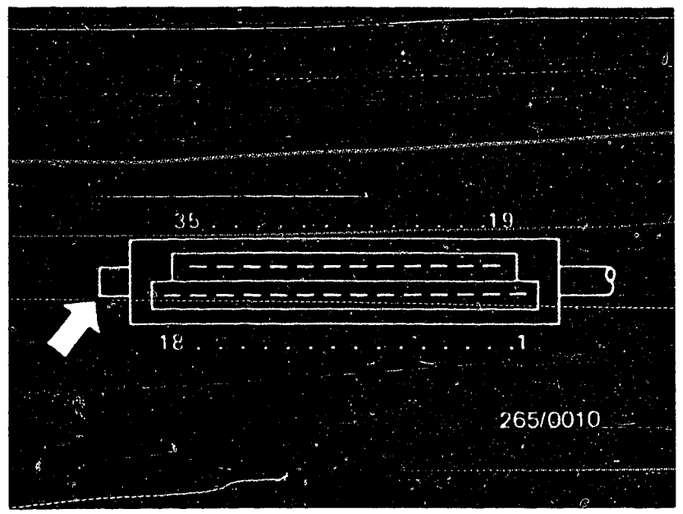
1. Indicator lamp defective.
2. Open circuit in lead to ignition lock.
3. Check for open circuit in leads from multiple plug K1/term. 29 to hydraulic modulator K3/term. 7.
4. Using ohmmeter, check diode in forward and reverse directions between K4/term. 4 and K4/term. 7.

Reading not within tolerance:

1. Using ohmmeter, check diode in forward and reverse directions between K4/term. 4 and K4/term. 7.
2. Check for open circuit in lead between multiple plug K1/term. 29 and ABS indicator lamp.
3. Check plug-in connections at indicator lamp, K3/term. 7, K4/term. 7, K3/term. 8, K4/term. 8 as well as ground lead and valve relay plug-connections for voltage drop. If diode defective, replace hydraulic modulator.

Continued on E9/E10

Top view of multiple plug K1 (35-pin) with terminal numbers
Arrow = Lug with mechanical plug



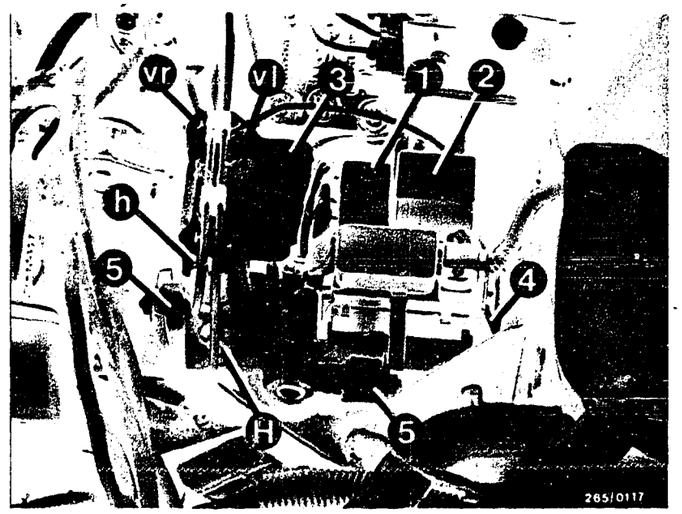
Trouble-shooting for TEST STEP 18 (continued)

Removing the hydraulic modulator

- For safety reasons, the hydraulic modulator must not be repaired, but the complete unit must be replaced.
 Exceptions to this are the return-pump relay and the valve relay. Both relays may be replaced.

- Apart from the brake-line connections, no screws on the hydraulic modulator may be loosened or removed. Under no circumstances may the hexagon-socket-head cap screws (arrows) be loosened. After loosening, it is no longer possible to get the brake circuits leak-tight or the brake circuits can no longer be bled.
 Danger!

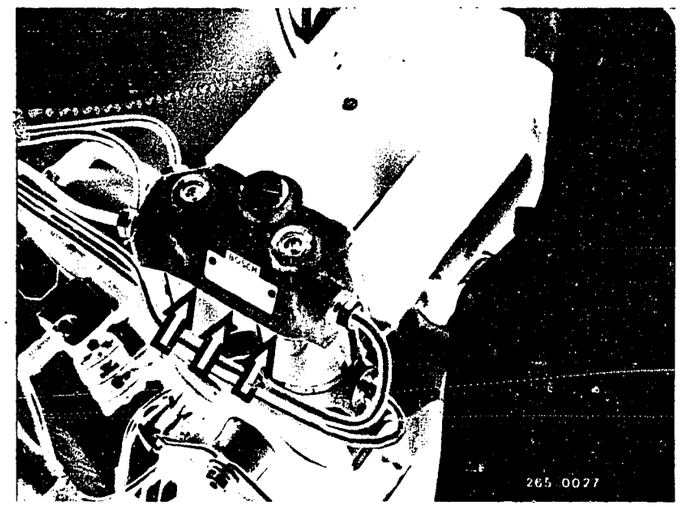
- Visually inspect hydraulic modulator and brake-line connections for leaks. Pay particular attention to the joints identified by arrows (bottom picture). If brake fluid is escaping, tighten the brake-line connections (12...16 Nm) or replace the hydraulic modulator.



1 = Valve relay
2 = Motor relay
3 = Hydraulic modulator
4 = Pump motor ground terminal
5 = Fastening screws

Continued on E 11/E 12

Arrows = Joints



Trouble-shooting - TEST STEP 18 (continued)

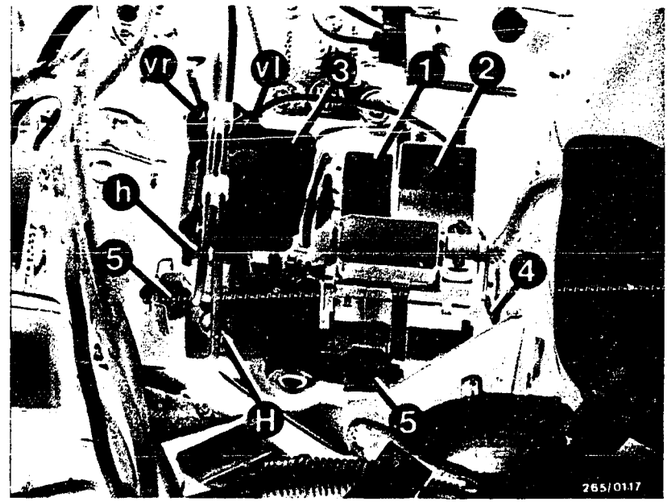
On the base of the hydraulic modulator there is a vent hole to the pump pistons. A slight escape of brake fluid is possible at this point.
A complaint is justified only if, after repeated operation of the brake pedal, there is a pool of brake fluid under the hydraulic modulator.

- When removing and installing the brake lines, make sure that the lines are marked in accordance with the markings on the hydraulic modulator and that they are not mixed up when re-connecting (e.g. FL of hydraulic modulator must be connected to the front left wheel brake cylinder).

- Markings on hydraulic modulator

VL = Connection for brake line front left (wheel brake cylinder)
VR = Connection for brake line front right (wheel brake cylinder)
HR = Connection for brake line rear right (wheel brake cylinder)

V = Front axle brake circuit from brake master cylinder
H = Rear axle brake circuit from brake master cylinder

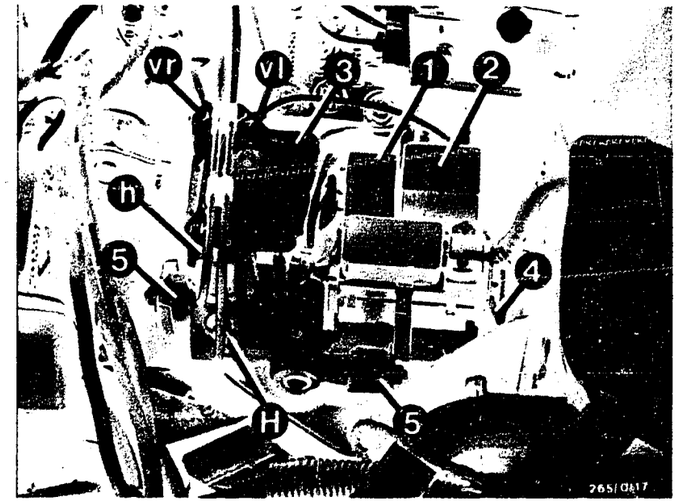


1 = Valve relay
2 = Motor relay
3 = Hydraulic modulator
4 = Pump motor ground terminal
5 = Fastening screws

Continued on E 13/E 14

Trouble-shooting for TEST STEP 18 (continued)

- Use only the specified double-end flare nut wrench 9x11 mm for loosening and tightening the brake lines.
- Mark brake lines and remove from hydraulic modulator.
- Catch the brake fluid and do not bring it into contact with your skin or clothing or with paintwork.
- Immediately seal the brake lines and connections with dummy plugs.
- Disconnect ground lead from pump motor.
- Loosen fastening screw and take off cover.
- Loosen bracket and take off the plug.
- Loosen hexagon nuts from holder and take off hydraulic modulator.



1 = Valve relay
2 = Motor relay
3 = Hydraulic modulator
4 = Pump motor ground terminal
5 = Fastening screws

Installation

- Mount hydraulic modulator in the holder and fasten with the hexagon nuts.
- Connect ground cable to pump motor. Plug on 12-pin plug and fasten with the bracket.
- Secure cover on hydraulic modulator with the screw.
- Connect the brake lines to the hydraulic modulator in accordance with the markings.
- Observe the tightening torque for the brake-line connections on the hydraulic modulator: 12...16 Nm.
- Bleed the brake system and check for leaks.
- Fully test the ABS with the tester.

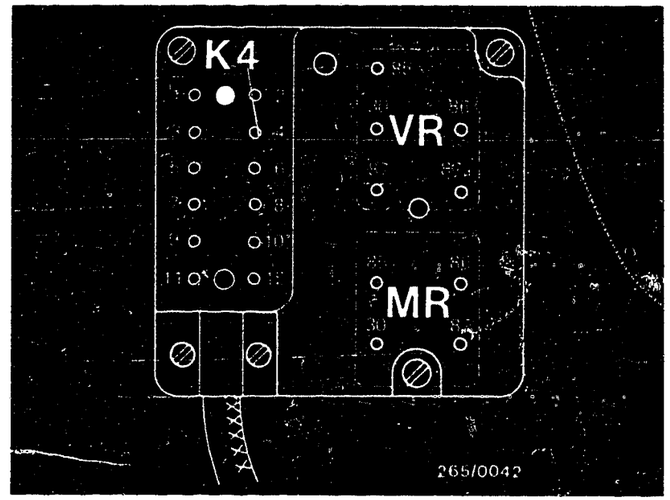
TEST STEP 19

Operation:		Reading:	Testing:
Program-selector switch position	15	Digital display unit must indicate 2.5 ... 8.5 V Note: ABS indicator lamp slightly dimmer. Valve relay switches.	Component: Hydraulic modulator
Operation in vehicle: Switch on ignition		If reading O.K., continue testing with next test step.	Operation: Diode in reverse direction Malfunction: Reading less than 2.5 V or greater than 8.5 V.

Trouble-shooting (switch off ignition):

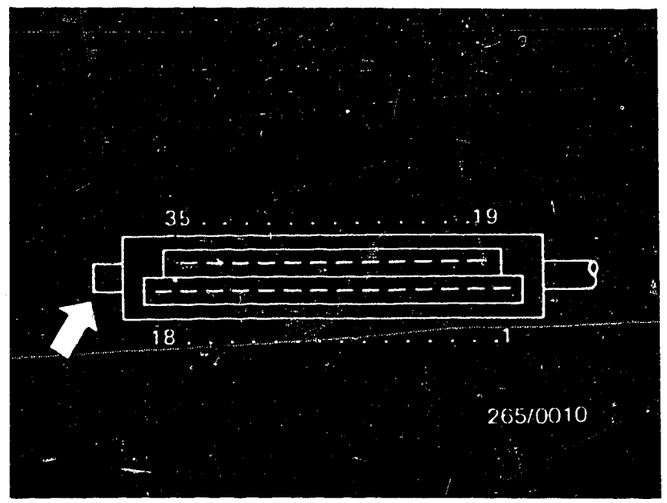
Reading outside tolerance:
Check diode in forward and reverse directions with ohmmeter between K4/term. 4 and K4/term. 7.
If diode defective, replace hydraulic modulator.

Continued on E17/E18



Top view of plug-in plate of hydraulic modulator
VR = Valve relay
MR = Return-pump relay
K4 = Wiring harness plug

Top view of multiple plug K1 (35-pin) with terminal numbers
Arrow = Lug with mechanical plug



Trouble-shooting for TEST STEP 19 (continued)

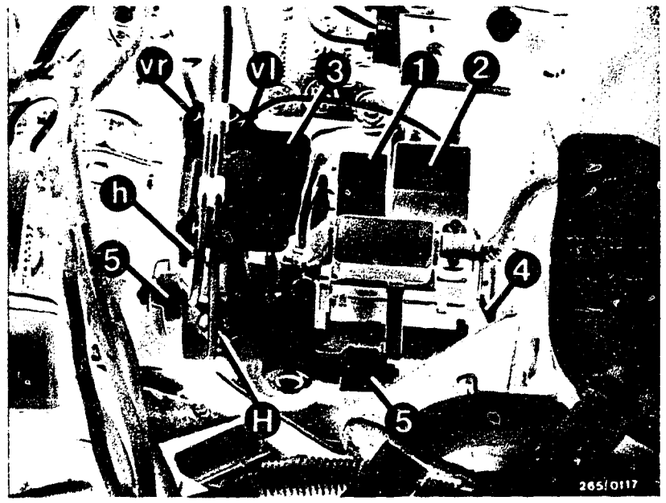
Removing the hydraulic modulator

- For safety reasons, the hydraulic modulator must not be repaired, but the complete unit must be replaced.
 Exceptions to this are the return-pump relay and the valve relay. Both relays may be replaced.

- Apart from the brake-line connections, no screws on the hydraulic modulator may be loosened or removed. Under no circumstances may the hexagon-socket-head cap screws (arrows) be loosened. After loosening, it is no longer possible to get the brake circuits leak-tight or the brake circuits can no longer be bled.
 Danger!

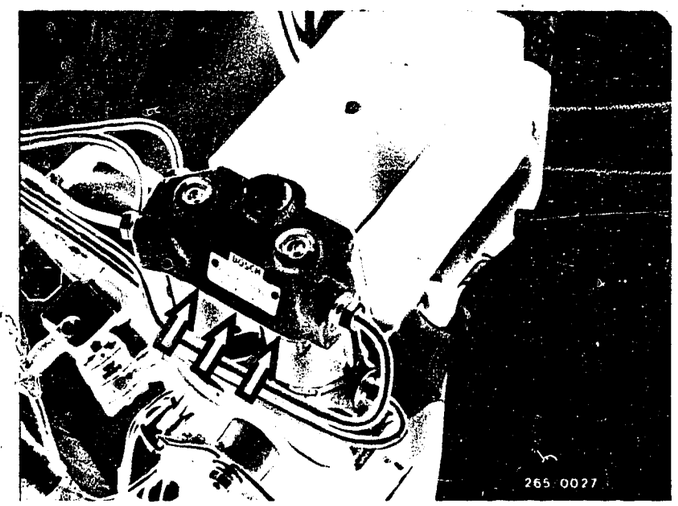
- Visually inspect hydraulic modulator and brake-line connections for leaks. Pay particular attention to the joints identified by arrows (bottom picture). If brake fluid is escaping, tighten the brake-line connections (12...16 Nm) or replace the hydraulic modulator.

Continued on E 19/E 20



1 = Valve relay
2 = Motor relay
3 = Hydraulic modulator
4 = Pump motor ground terminal
5 = Fastening screws

Arrows = Joints



Trouble-shooting - TEST STEP 19 (continued)

On the base of the hydraulic modulator there is a vent hole to the pump pistons. A slight escape of brake fluid is possible at this point.
A complaint is justified only if, after repeated operation of the brake pedal, there is a pool of brake fluid under the hydraulic modulator.

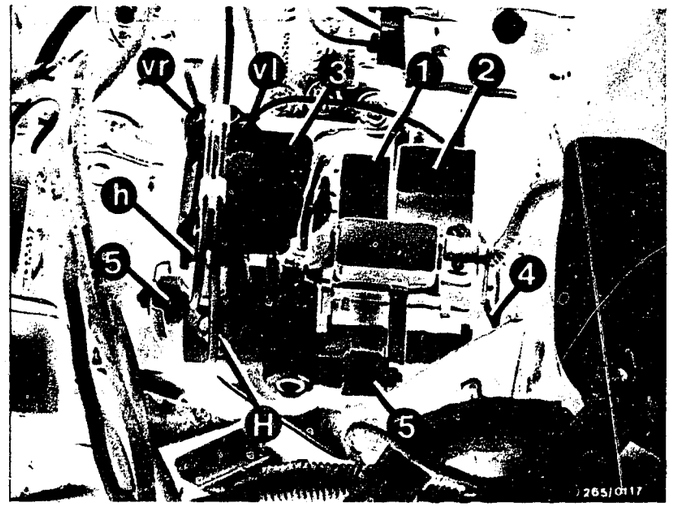
- When removing and installing the brake lines, make sure that the lines are marked in accordance with the markings on the hydraulic modulator and that they are not mixed up when re-connecting (e.g. FL of hydraulic modulator must be connected to the front left wheel brake cylinder).

- Markings on hydraulic modulator

VL = Connection for brake line front left (wheel brake cylinder)
VR = Connection for brake line front right (wheel brake cylinder)
HR = Connection for brake line rear right (wheel brake cylinder)

V = Front axle brake circuit from brake master cylinder
H = Rear axle brake circuit from brake master cylinder

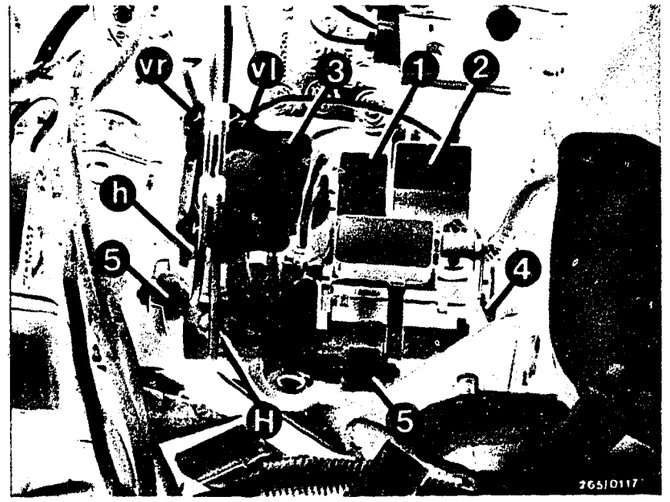
Continued on E 21/E 22



1 = Valve relay
2 = Motor relay
3 = Hydraulic modulator
4 = Pump motor ground terminal
5 = Fastening screws

Trouble-shooting for TEST STEP 19 (continued)

- Use only the specified double-end flare nut wrench 9x11 mm for loosening and tightening the brake lines.
- Mark brake lines and remove from hydraulic modulator.
- Catch the brake fluid and do not bring it into contact with your skin or clothing or with paintwork.
- Immediately seal the brake lines and connections with dummy plugs.
- Disconnect ground lead from pump motor.
- Loosen fastening screw and take off cover.
- Loosen bracket and take off the plug.
- Loosen hexagon nuts from holder and take off hydraulic modulator.



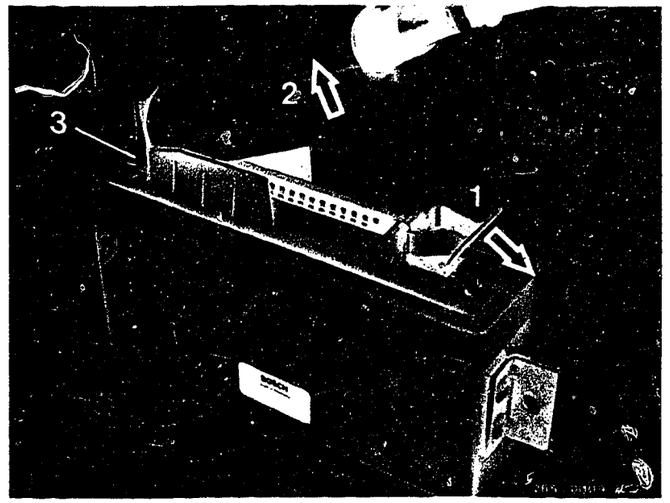
1 = Valve relay
2 = Motor relay
3 = Hydraulic modulator
4 = Pump motor ground terminal
5 = Fastening screws

Installation

- Mount hydraulic modulator in the holder and fasten with the hexagon nuts.
- Connect ground cable to pump motor. Plug on 12-pin plug and fasten with the bracket.
- Secure cover on hydraulic modulator with the screw.
- Connect the brake lines to the hydraulic modulator in accordance with the markings.
- Observe the tightening torque for the brake-line connections on the hydraulic modulator: 12...16 Nm.
- Bleed the brake system and check for leaks.
- Fully test the ABS with the tester.

TEST STEP 20

Operation:		Reading:	Testing:
Program-selector switch position	16	Watch ABS indicator lamp in vehicle: After pressing the illuminated key the lamp must go out within 1 second	Component: Controller
Illuminated key lights up. Press key for at least 3 seconds.	●	If reading O.K., continue testing with next test step.	Operation: BITE* triggering
Operation in vehicle: Switch off ignition			Malfunction: Indicator lamp does not go out



1 = Spring
2 = Multiple plug (35-pin)
3 = Encoding block

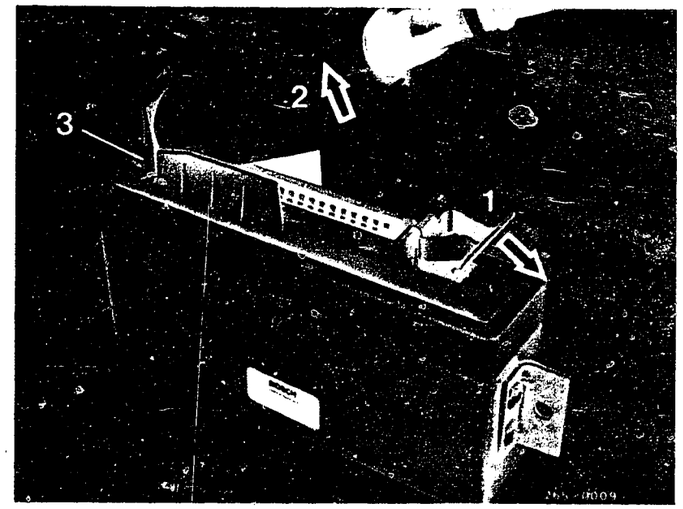
Trouble-shooting:
1. Repeat test step with engine running.
2. Replace controller (switch off ignition beforehand).

Notes:
- Switch off ignition before disconnecting multiple plug.
- To disconnect multiple plug, press back spring, hinge up multiple plug and unhook from encoding block.
- Install only the specified controller.
- When installing, make sure that the multiple plug locks into the spring.

*BITE = Built-in test circuit

TEST STEP 21

Operation:		Reading:	Testing:
Program-selector switch position	17	Watch ABS indicator lamp in vehicle: Lamp must light up as long as the key is pressed.	Component: Controller
Illuminated key lights up. Press key for at least 3 seconds.	●	If reading O.K., continue testing with next test step.	Operation: BITE* program with fault simulation
Operation in vehicle: Switch on ignition			Malfunction: Indicator lamp goes out.



1 = Spring
2 = Multiple plug (35-pin)
3 = Encoding block

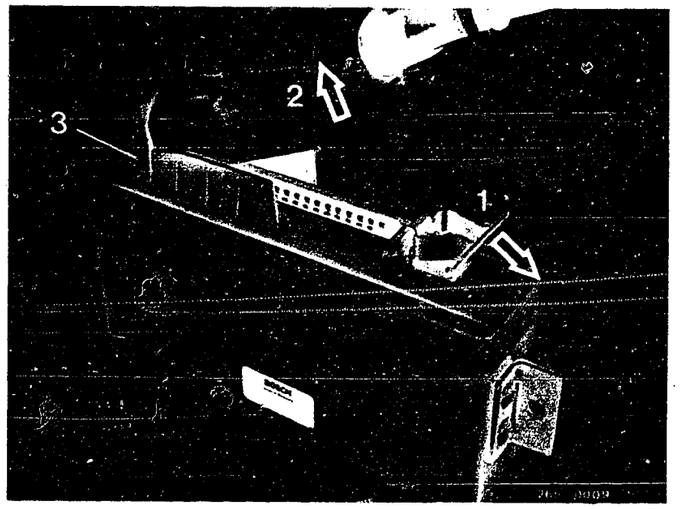
Trouble-shooting:
1. Repeat test step with engine running.
2. Replace controller (switch off ignition beforehand).

Notes:
- Switch off ignition before disconnecting multiple plug.
- To disconnect multiple plug, press back spring, hinge up multiple plug and unhook from encoding block.
- Install only the specified controller.
- When installing, make sure that the multiple plug locks into the spring.

*BITE = Built-in test circuit

TEST STEP 22

Operation:		Reading:	Testing:
Program-selector switch position	18	Digital display unit must indicate 1.9 ... 2.3 A	Component: Controller
Press key FL	●		
Illuminated key lights up. Press key. (Reading must be at zero before pressing the key).	●	Note: Pump motor starts up. If reading OK, continue testing with next test step.	Operation: Valve current. Pressure holding front left
Operation in vehicle: Switch on ignition			Malfunction: Current less than 1.9 A or greater than 2.3 A



1 = Spring
2 = Multiple plug (35-pin)
3 = Encoding block

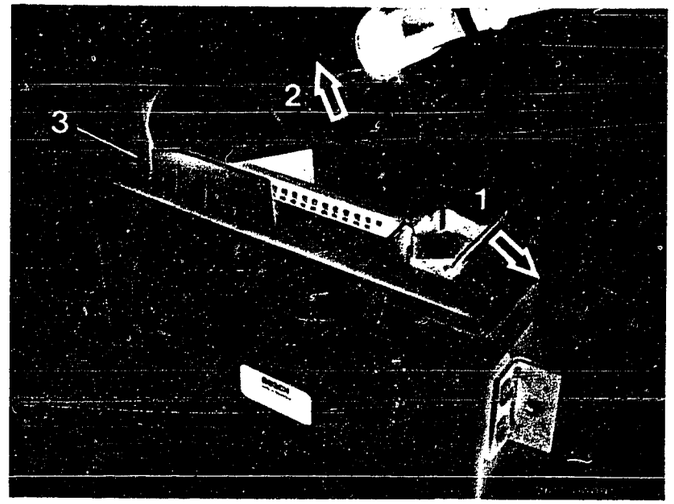
Trouble-shooting:

1. Repeat test step with engine running.
2. Replace controller (switch off ignition beforehand).

Notes:

- Display jumps to zero after a few seconds.
 If the test step is to be repeated, press the key again.
- Switch off the ignition before disconnecting the multiple plug.
- To disconnect the multiple plug, push back the spring, hinge up the multiple plug and unhook from encoding block.
- Install only the specified controller.
- When installing, make sure that the multiple plug locks into the spring.

TEST STEP 23 Operation:		Reading:	Testing:
Program-selector switch position	18	Digital display unit must indicate 1.9 ... 2.3 A	Component: Controller
Press key F'R	●		
Illuminated key lights up. Press key. (Reading must be at zero before pressing the key).	●	Note: Pump motor starts up.	Operation: Valve current. Pressure holding front right
Operation in vehicle: Switch on ignition		If reading O.K., continue testing with next test step.	Malfunction: Current less than 1.9 A or greater than 2.3 A



1 = Spring
2 = Multiple plug (35-pin)
3 = Encoding block

Trouble-shooting:

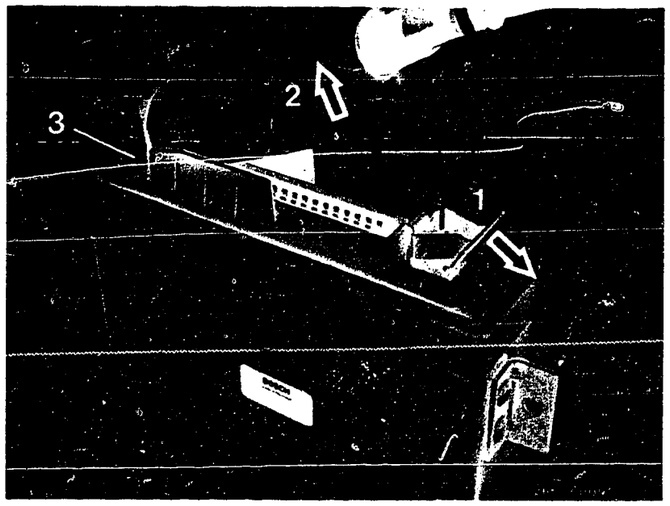
1. Repeat test step with engine running.
2. Replace controller (switch off ignition beforehand).

Notes:

- Display jumps to zero after a few seconds.
 If the test step is to be repeated, press the key again.
- Switch off the ignition before disconnecting the multiple plug.
- To disconnect the multiple plug, push back the spring, hinge up the multiple plug and unhook from endocing block.
- Install only the specified controller.
- When installing, make sure that the multiple plug locks into the spring.

TEST STEP 24

Operation:		Reading:	Testing:
Program-selector switch program	18	Digital display unit must indicate 1.9 ... 2.3 A	Component: Controller
Press key RA	●		Operation: Valve current. Pressure-holding - rear left
Illuminated key lights up. Press key. (Reading must be at zero before pressing the key).	●	Note: Pump motor starts up. If reading O.K., continue testing with next test step.	Malfunction: Current less than 1.9 A or greater than 2.3 A
Operation in vehicle: Switch on ignition			



1 = Spring
2 = Multiple plug (35-pin)
3 = Encoding block

Trouble-shooting:

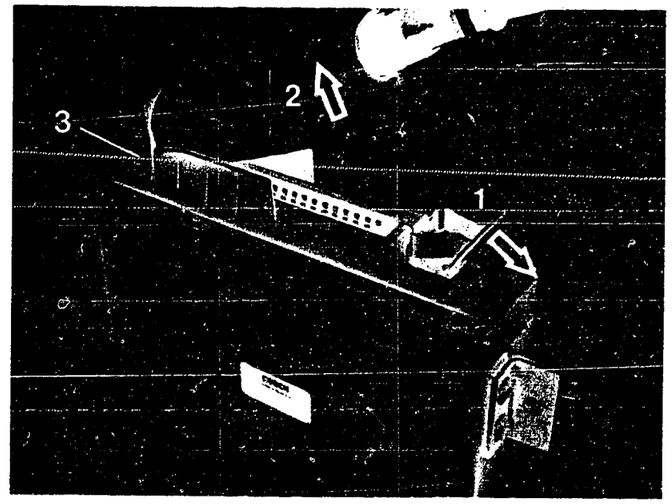
1. Repeat test step with engine running.
2. Replace controller (switch off ignition beforehand).

Notes:

- Display jumps to zero after a few seconds.
 If the test step is to be repeated, press the key again.
- Switch off the ignition before disconnecting the multiple plug.
- To disconnect the multiple plug, push back the spring, hinge up the multiple plug and unhook from encoding block.
- Install only the specified controller.
- When installing, make sure that the multiple plug locks into the spring.

TEST STEP 26 (Test step 25 not applicable)

Operation:		Reading:	Testing:
Program-selector switch position	19	Digital display unit must indicate 4,5...6,0 A	Component: Controller
Press key FL	●		Operation: Valve current, pressure reduction front left
Illuminated key lights up. Press key. (Reading must be at zero before pressing the key)	●	Note: Pump motor starts up. If reading O.K., continue testing with next test step.	Malfunction: Current less than 4.5 A or greater than 6,0 A.
Operation in vehicle: Switch on ignition			



1 = Spring
2 = Multiple plug (35-pin)
3 = Encoding block

Trouble-shooting:

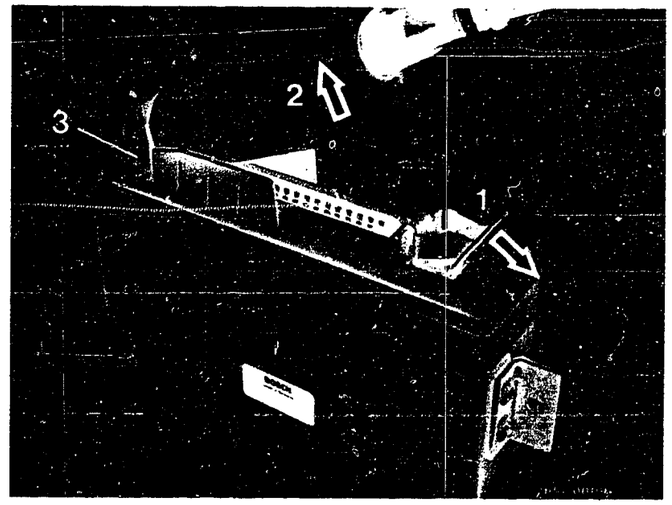
1. Repeat test step with engine running.
2. Replace controller (switch off ignition beforehand).

Notes:

- Display jumps to zero after a few seconds. If the test step is to be repeated, press the key again.
- Switch off the ignition before disconnecting the multiple plug.
- To disconnect the multiple plug, push back the spring, hinge up the multiple plug and unhook from encoding block.
- Install only the specified controller.
- When installing, make sure that the multiple plug locks into the spring.

TEST STEP 27

Operation:		Reading:	Testing:
Program-selector switch position	19	Digital display unit must indicate 4,5...6,0 A	Component: Controller
Press key FR	●		Operation: Valve current, pressure reduction front right
Illuminated key lights up. Press key. (Reading must be at zero before pressing the key)	●	Note: Pump motor starts up If reading O.K., continue testing with next test step.	Malfunction: Current less than 4.5 A or greater than 6,0 A.
Operation in vehicle: Switch on ignition			



1 = Spring
2 = Multiple plug (35-pin)
3 = Encoding block

Trouble-shooting:

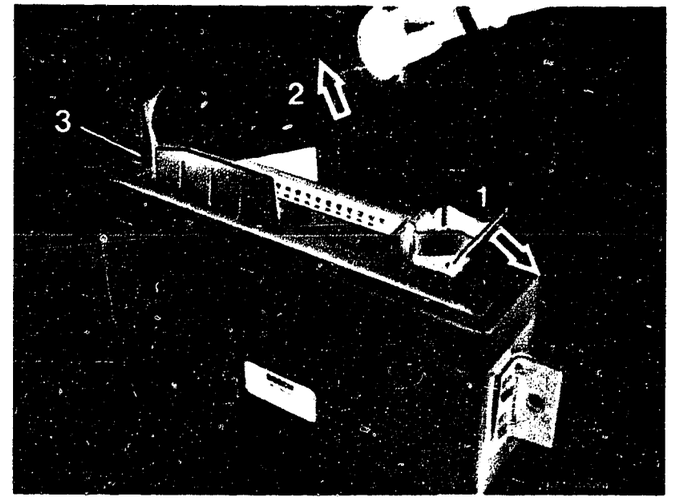
1. Repeat test step with engine running.
2. Replace controller (switch off ignition beforehand).

Notes:

- Display jumps to zero after a few seconds.
 If the test step is to be repeated, press the key again.
- Switch off the ignition before disconnecting the multiple plug.
- To disconnect the multiple plug, push back the spring, hinge up the multiple plug and unhook from encoding block.
- Install only the specified controller.
- When installing, make sure that the multiple plug locks into the spring.

TEST STEP 28

Operation:		Reading:	Testing:
Program-selector switch position	19	Digital display unit must indicate 4.5 ... 6.0 A	Component: Controller
Press key RA	●		
Illuminated key lights up. Press key. (Reading must be at zero before pressing the key)	●	Note: Pump motor starts up. If reading O.K., continue testing with next test step.	Operation: Valve current, Pressure-reduction, rear left
Operation in vehicle: Switch on ignition			Malfunction: Current less than 4.5 A or greater than 6.0 A.



1 = Spring
2 = Multiple plug (35-pin)
3 = Encoding block

Trouble-shooting:

1. Repeat test step with engine running.
2. Replace controller (switch off ignition beforehand).

Notes:

- Display jumps to zero after a few seconds.
 If the test step is to be repeated, press the key again.
- Switch off the ignition before disconnecting the multiple plug.
- To disconnect the multiple plug, push back the spring, hinge up the multiple plug and unhook from encoding block.
- Install only the specified controller.
- When installing, make sure that the multiple plug locks into the spring.

A dynamic brake analyzer (DBA) is necessary for program-selector switch positions 20, 21, 22 and 23.

Caution:

Do not drive with the tester connected.

Do not use a brake-pedal actuating device for setting the brake-pedal force.

Bring test step - program switch position 23 - forward since the following test steps presuppose that the wheel-speed sensors are in good condition. When changing channels wait at least 20 seconds (internal tester program must have run).
Be sure to keep to the sequence of operations.
Start testing with front axle.

TEST STEP 31

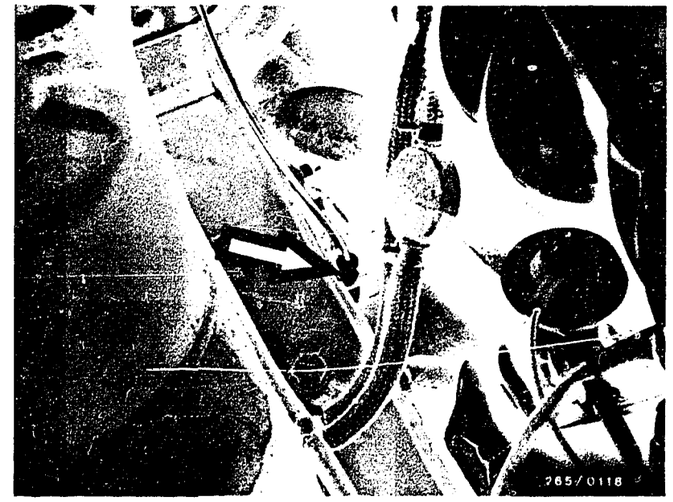
Operation:		Reading:	Testing:
Program-selector switch position	23	Digital display unit must indicate 1,8 ... 19 In case of fluctuating readings, the lowest reading is valid. Note: If reading is 1,8, check air gap. If reading O.K., continue testing with next test step.	Component: Wheel-speed sensor front left Operation: Signal and mixing up of connecting cables Malfunction: Reading less than 1,8 or greater than 19

Additional operations:

- Drive front wheels of vehicle onto dynamic brake analyzer
- Pull on the handbrake.

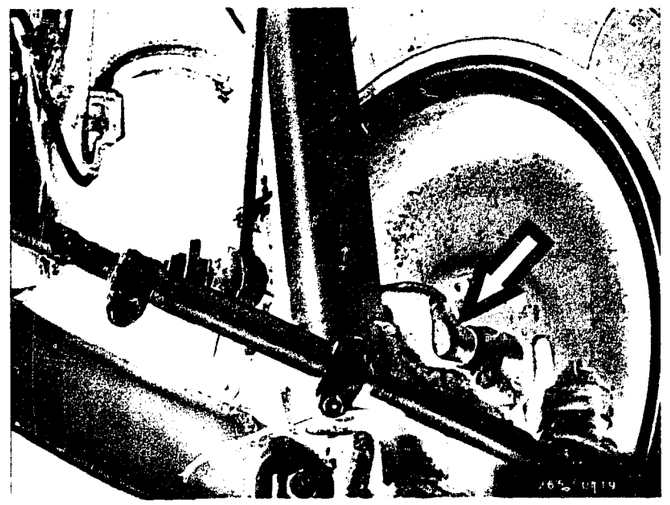
Caution:
In vehicles with automatic transmission, make sure that selector lever is not in parking position.

- Switch on ignition.
- Select wheel FL with key FL.
- Switch on left-hand brake roller.
- Make reading.



Arrow = Wheel-speed sensor plug-in connector

Arrow = Wheel-speed sensor



Trouble-shooting (switch off ignition)

A reading of 999 signifies:

- Speed of dynamic brake analyzer too great (above approx. 13 km/h).

Reading 0 or less than 1,8

- Wheel-speed sensors mixed up? Check assignment:
 Wheel-speed sensors must be connected to the specified wheel and controller input (see circuit diagram).
- Air gap between wheel-speed sensor and ring gear too great. Check installation.
- Check wheel bearing play.
- Replace wheel-speed sensor.

Continued on G 1/G 2

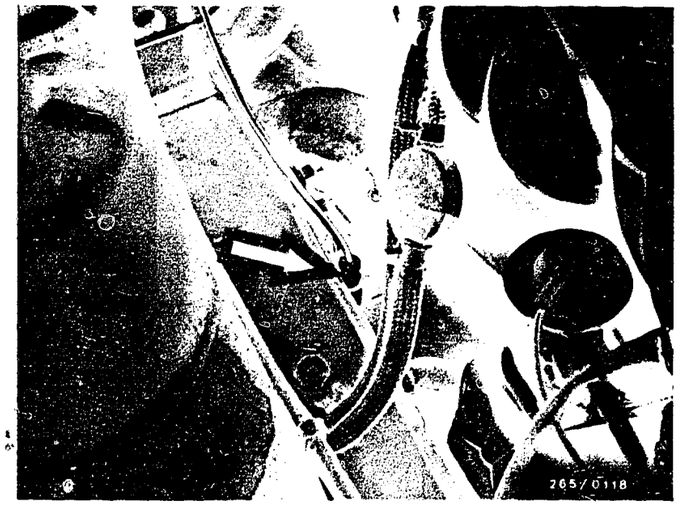
Trouble-shooting for TEST STEP 31 (continued)

Removing front-axle wheel-speed sensors

- The plug connectors are on the respective frame side member.
- Take plug connector out of holder and take apart.
- Remove wheel-speed sensor lead from fastening clamps.
- Loosen fastening screw for wheel-speed sensor and carefully take out wheel-speed sensor. Do not use force.

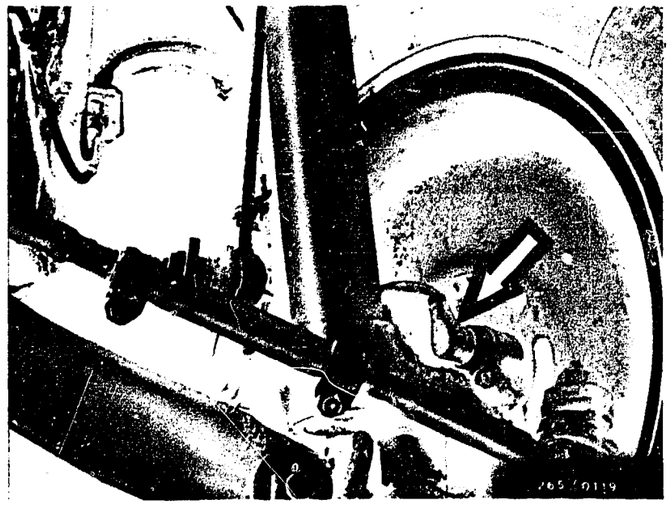
Install wheel-speed sensor on front axle.

- Check O-ring for cracks and replace if necessary.
- Only take new wheel-speed sensor out of protective sleeve when ready for mounting.
- Grease wheel-speed sensor housing lightly with Molykote Longterm 2.
- Make sure that no metallic foreign bodies are on the permanently magnetic edge.
- Carefully press wheel-speed sensor into mounting hole as far as it will go. Do not knock.
- Use new micro-encapsulated fastening screws.
 Tighten fastening screws to 8 Nm.
- Re-secure lead at the intended places.
- Connect wheel-speed sensor to ABS wiring harness and clip plug connector into holder.
- After repairing, test with ABS tester.



Arrow = Wheel-speed sensor plug-in connector

Arrow = Wheel-speed sensor



TEST STEP 32

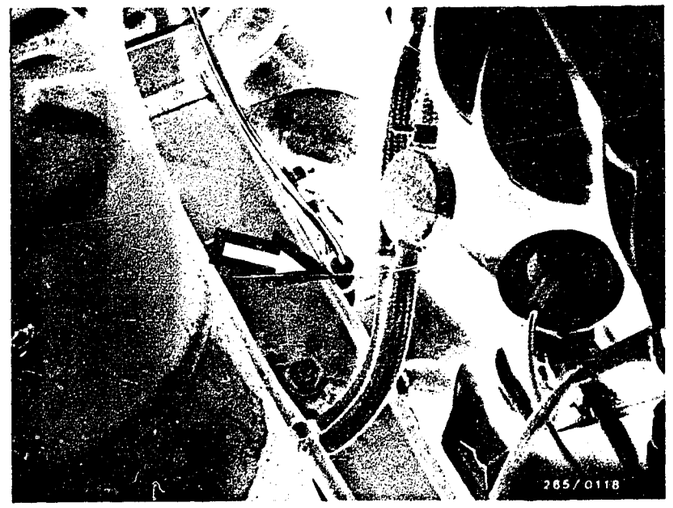
Operation:		Reading:	Testing:
Program-selector switch position	23	Digital display unit must indicate 1,8 ... 19 In case of fluctuating readings, the lowest reading is valid. Note: If reading is 1,9, check air gap. If reading O.K., continue testing with next test step.	Component: Wheel-speed sensor front right Operation: Signal and mixing up of connecting cables Malfunction: Reading less than 1,8 or greater than 19

Additional operations:

- Drive front wheels of vehicle onto dynamic brake analyzer
- Pull on the handbrake.

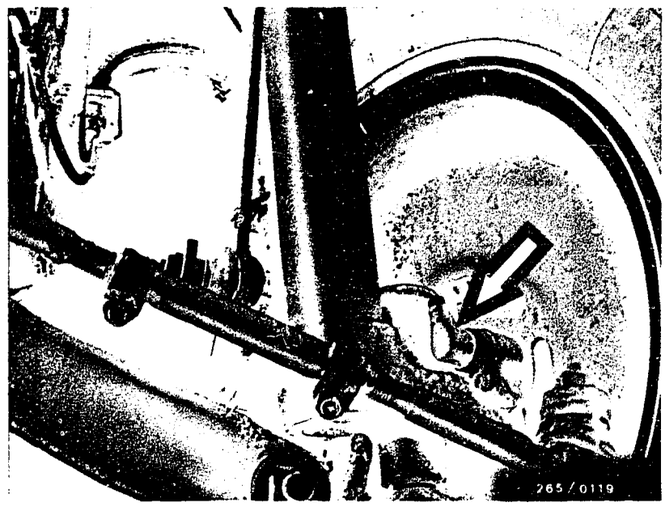
Caution:
In vehicles with automatic transmission, make sure that selector lever is not in parking position.

- Switch on ignition
- Select wheel FR with key FR
- Switch on right-hand brake roller only
- Make reading.



Arrow = Wheel-speed sensor plug-in collector

1 = Wheel-speed sensor
2 = Fastening plate



Trouble-shooting (switch off ignition)

A reading of 999 signifies:

- Speed of dynamic brake analyzer too great (above approx. 13 km/h).

Reading 0 or less than 1,8

- Wheel-speed sensors mixed up? Check assignment:
 Wheel-speed sensors must be connected to the specified wheel and controller input (see circuit diagram).
- Air gap between wheel-speed sensor and ring gear too great. Check installation.
- Check wheel bearing play.
- Replace wheel-speed sensor.

Continued on G 5/G 6

TEST STEP 30	Best to perform this test step first. (Test step 29 not applicable)		
Operation:		Reading:	Testing:
Program-selector switch position	24	Digital display unit must indicate 10 ... 15 V	Component: Stop-lamp switch
Operation in vehicle: Switch on ignition. Press brake pedal.		If reading O.K., continue testing with next test step.	Operation: Signal Malfunction: Reading less than 10 V

Note: Tester must be converted for generation 2B.

Trouble-shooting:
No reading: Fuse no. 7 for stop-lamp switch in fuse box defective.
Check stop-lamp switch including plug connectors and leads.
Reading less than 10 V: Stop lamps defective, eliminate contact resistances at plug connectors or replace stop-lamp switch.

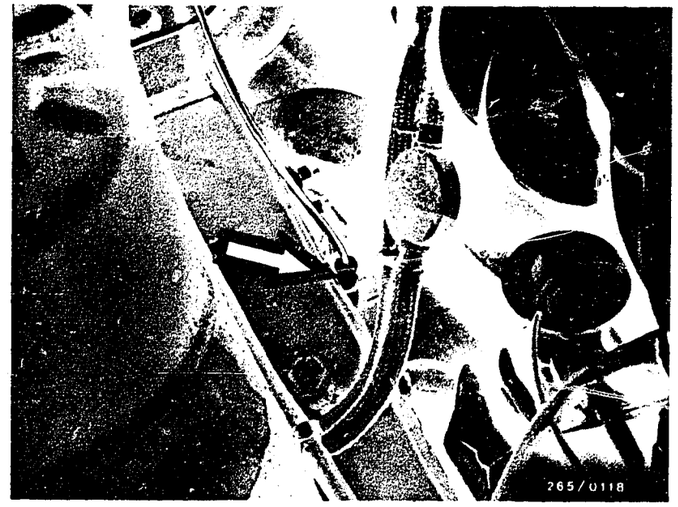
Trouble-shooting for TEST STEP 32 (continued)

Removing front-axle wheel-speed sensors

- The plug connectors are on the respective frame side member.
- Take plug connector out of holder and take apart.
- Remove wheel-speed sensor lead from fastening clamps.
- Loosen fastening screw for wheel-speed sensor and carefully take out wheel-speed sensor. Do not use force.

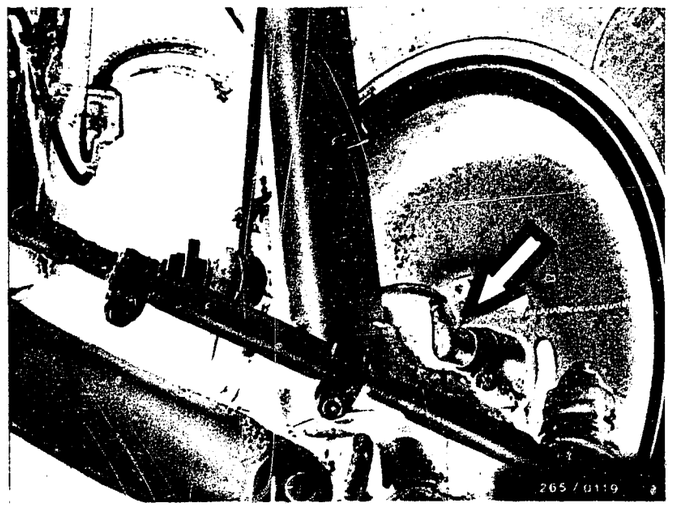
Install wheel-speed sensor on front axle.

- Check O-ring for cracks and replace if necessary.
- Only take new wheel-speed sensor out of protective sleeve when ready for mounting.
- Grease wheel-speed sensor housing lightly with Molykote Longterm 2.
- Make sure that no metallic foreign bodies are on the permanently magnetic edge.
- Carefully press wheel-speed sensor into mounting hole as far as it will go. Do not knock.
- Use new micro-encapsulated fastening screws.
 Tighten fastening screws to 8 Nm.
- Re-secure lead at the intended places.
- Connect wheel-speed sensor to ABS wiring harness and clip plug connector into holder.
- After repairing, test with ABS tester.



Arrow = Wheel-speed sensor plug-in collector

1 = Wheel-speed sensor
2 = Fastening plate



TEST STEP 33

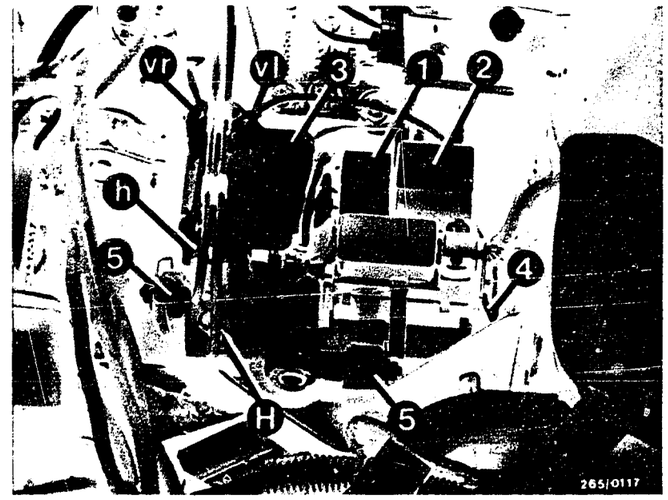
Operation:		Reading:	Testing:
Program-selector switch position	20	Instruments on dynamic brake analyzer: Left-hand reading drops to a value below 1000 N (100 kgf) If reading OK, continue testing with next test step.	Component: Hydraulic modulator, front axle Operation: Mixing up of brake lines Malfunction: Reading does not drop.

Additional operation:

- Let engine run
- Select program switch position 20 and select wheel FL with key FL.
- Switch on left-hand brake roller.
- Press brake pedal until braking-force reading on dynamic brake analyzer is 2000 N (200 kp).
- Press illuminated key.
- Pressure reduction on corresponding wheel (front left) must take place.
- Release brake pedal and illuminated key (keep to sequence of operations so that vehicle does not jump out of rollers).

Trouble-shooting:

- Lamp 2 (red) must not light up.
- Repeat test (possibly with engine stopped and without brake booster operating).
- Brake lines on hydraulic modulator mixed up?
- Check assignment of brake roller to key FL again.



1 = Valve relay
2 = Return-pump relay
l = Connection for brake line front left (wheel-brake cyl.)
r = Connection for brake line front right (wheel-brake cyl.)
h = Connection for brake line rear axle (wheel-brake cyl.)
V = Brake line to brake master cylinder (brake circuit for front axle)
H = Brake line to brake master cylinder (brake circuit for rear axle)

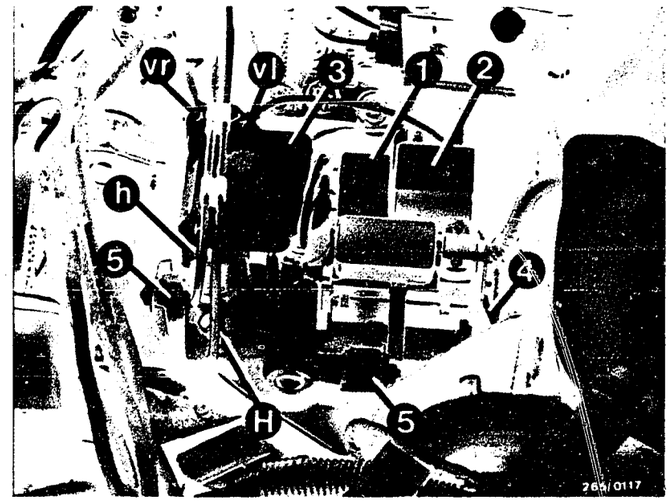
Caution!
Under no circumstances may the hexagon-socket-head cap screws be loosened.
After loosening, it is no longer possible to get the brake circuits leak-tight or they can no longer be bled.
Danger!

TEST STEP 34

Operation:		Reading:	Testing:
Program-selector switch position	20	Instruments on dynamic brake analyzer: Right-hand reading drops to a value below 1000 N (100 kgf)	Component: Hydraulic modulator, front axle
Additional operations: • Let the engine run. • Switch off left-hand brake roller. • Switch on right-hand brake roller. • Select wheel FR with key FR. • Using brake pedal, produce braking force of 2000 N (200 kgf). • Press illuminated key. • There must be a pressure reduction on the corresponding wheel (front right). • Release brake pedal and illuminated key. (Follow the sequence of operations so that the vehicle does not jump out of the rollers).		If reading O.K., continue testing with next test step.	Operation: Mixing up of brake lines Malfunction: Reading does not drop.

Trouble-shooting:

- Lamp 2 (red) must not light up.
- Repeat test (possibly with engine stopped and without operation of brake booster)
- Brake lines on hydraulic modulator mixed up?
 Note markings.
- Check assignment of brake roller to key FR once again.



1 = Valve relay
2 = Return-pump relay
l = Connection for brake line front left (wheel-brake cyl.)
r = Connection for brake line front right (wheel-brake cyl.)
h = Connection for brake line rear axle (wheel-brake cyl.)
V = Brake line to brake master cylinder (brake circuit for front axle)
H = Brake line to brake master cylinder (brake circuit for rear axle)

Caution!
Under no circumstances may the hexagon-socket-head cap screws be loosened.
After loosening, it is no longer possible to get the brake circuits leak-tight or they can no longer be bled.
Danger!

TEST STEP 35

Operation:		Reading:	Testing:
Program-selector switch position	20	Instruments on dynamic brake analyzer: Left-hand reading drops to a value below 1000 N (100 kgf) If reading OK, continue testing with next test step.	Component: Hydraulic modulator Operation: Pressure reduction in brake lines front left. Malfunction: Braking force reading greater than 1000 N.

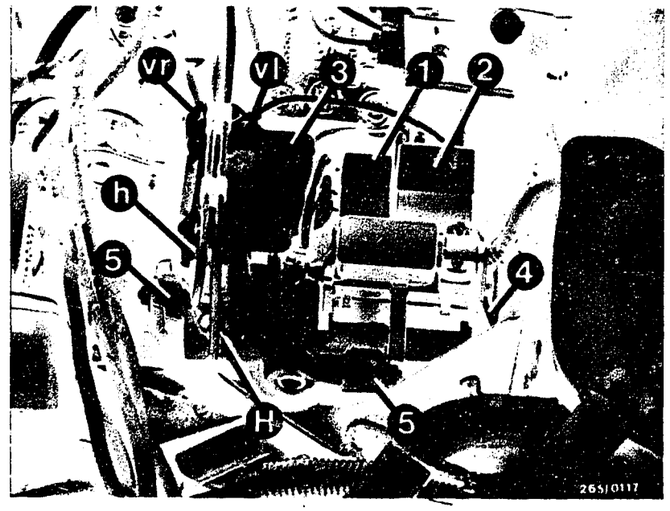
Additional operations:

- Let the engine run.
- Switch on left-hand and right hand brake rollers.
- Select wheel FL with key FL.
- Depress brake pedal until instrument on dynamic brake analyzer indicates 2000 N (200 kgf) for the left-hand side.
 Brake pedal force must not be changed throughout the entire testing procedure.
- Right-hand reading may differ by no more than 500 N (50 kgf) from the left-hand reading.
- Press illuminated key until test is completed (approx. 10 seconds).
- Read off left-hand reading.
- Release brake pedal and illuminated key (follow the sequence of operations so that the vehicle does not jump out of the rollers).

Trouble-shooting

- Lamp 2 (red) must not light up.
- Repeat the test twice and make sure that the braking force is not changed during the testing procedure.
 Repeat test possibly with engine stopped and without operation of brake booster.

Continued on G 13



1 = Valve relay
2 = Return-pump relay
l = Connection for brake line front left (wheel-brake cyl.)
r = Connection for brake line front right (wheel-brake cyl.)
h = Connection for brake line rear axle (wheel-brake cyl.)
V = Brake line to brake master cylinder (brake circuit for front axle)
H = Brake line to brake master cylinder (brake circuit for rear axle)

Caution!
Under no circumstances may the hexagon-socket-head cap screws be loosened.
After loosening, it is no longer possible to get the brake circuits leak-tight or they can no longer be bled.
Danger!

TEST STEP 35

Trouble-shooting (continued)

- Rest of the brake system OK? Properly bled?
 Brake-line connections not leaking? Brake pads OK?
 Brake pads must not be "glazed". Brake discs OK?
 Brake must "grip" well.
 Brake master cylinder and wheel-brake cylinder OK?
 Wheel-brake cylinder and brake pads must move freely.
 Clean if necessary.
- Check ground terminals on pump motor and vehicle body.
- Check positive terminal on pump motor.
- Replace hydraulic modulator.

TEST STEP 36

Operation:		Reading:	Testing:
Program-selector switch position	20	Instruments on d dynamic brake analyzer: Right-hand reading drops to a value below 1000 N (100 kgf)	Component: Hydraulic modulator
			Operation: Pressure reduction in brake lines front right
		If reading O.K., continue testing with next test step.	Malfunction: Braking force reading greater than 1000 N

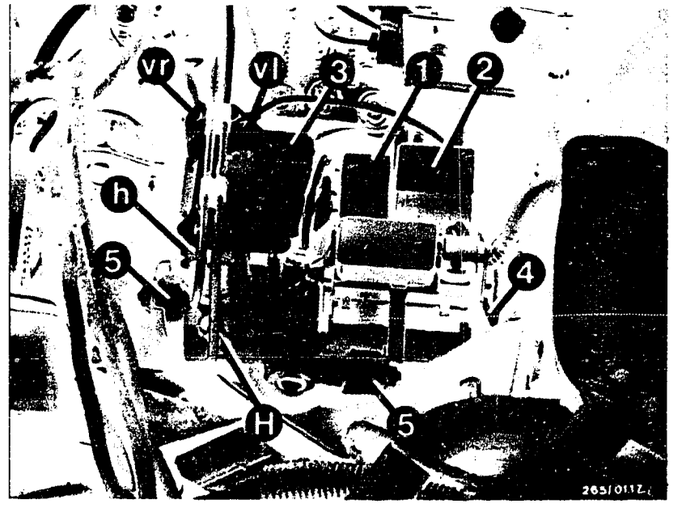
Additional operation:

- Let engine run
- Select wheel FR with key FR.
- Press brake pedal until instrument on dynamic brake analyzer shows 2000 N (200 kp) for right-hand side.
- Pedal force must not be changed throughout the entire test procedure.
- Left-hand reading may differ by max. 500 N (50 kp) from right-hand reading.
- Press illuminated key until test is completed (approx. 10 seconds).
- Make reading on right.
- Release brake pedal (keep to sequence of operations so that vehicle does not jump out of rollers).

Trouble-shooting

- Lamp 2 (red) must not light up.
- Repeat the test twice and make sure that the braking force is not changed during the testing procedure.
 Repeat test possibly with engine stopped and without operation of brake booster.

Continued on G 16



1 = Valve relay
2 = Return-pump relay
l = Connection for brake line front left (wheel-brake cyl.)
r = Connection for brake line front right (wheel-brake cyl.)
h = Connection for brake line rear axle (wheel-brake cyl.)
V = Brake line to brake master cylinder (brake circuit for front axle)
H = Brake line to brake master cylinder (brake circuit for rear axle)

Caution!
Under no circumstances may the hexagon-socket-head cap screws be loosened.
After loosening, it is no longer possible to get the brake circuits leak-tight or they can no longer be bled.
Danger!

TEST STEP 36

Trouble-shooting (continued)

- Rest of the brake system OK? Properly bled?
 Brake-line connections not leaking? Brake pads OK?
 Brake pads must not be "glazed". Brake discs OK?
 Brake must "grip" well.
 Brake master cylinder and wheel-brake cylinder OK?
 Wheel-brake cylinder and brake pads must move freely.
 Clean if necessary.
- Check ground terminals on pump motor and vehicle body.
- Check positive terminal on pump motor.
- Replace hydraulic modulator.

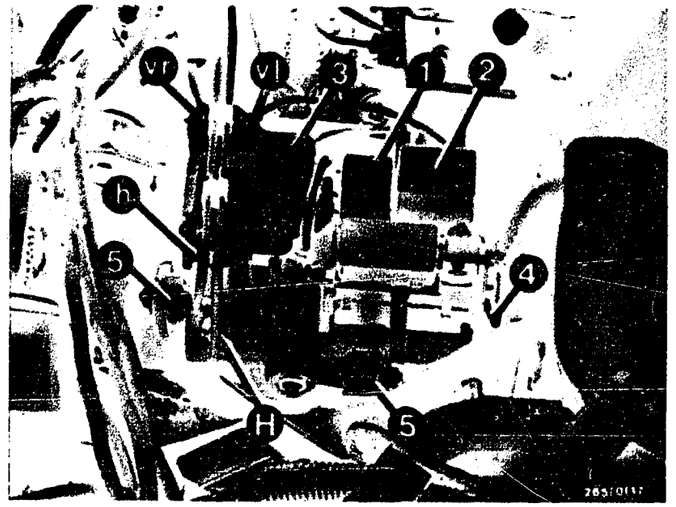
TEST STEP 37

Operation:		Reading:	Testing:
Program-selector switch position	21	Instruments on dynamic brake analyzer Left-hand reading drops briefly to an intermediate value and then rises again to 500...1400 N (50...140 kp).	Component: Hydraulic modulator
Additional operations: • Let the engine run. • Switch on both brake rollers. • Select wheel FL with key FL. • Press brake pedal until instrument on dynamic brake analyzer indicates 2000 N (200 kgf) for the left-hand side. • Brake pedal force must not be changed throughout the entire testing procedure. • Press illuminated key continuously until test is completed (approx. 10 seconds) • Read off left-hand reading. • Release brake pedal and illuminated key (follow the sequence of operations so that the vehicle does not jump out of the rollers).		If reading O.K., continue testing with next test step.	Operation: Pressure buildup in brake lines front left
			Malfunction: Braking-force reading less than 500 N or greater than 1400 N

Trouble-shooting

- Repeat the test twice and make sure that the braking force is not changed during the testing procedure.
 Repeat test possibly with engine stopped and without operation of brake booster.

Continued on G 19



1 = Valve relay
2 = Return-pump relay
l = Connection for brake line front left (wheel-brake cyl.)
r = Connection for brake line front right (wheel-brake cyl.)
h = Connection for brake line rear axle (wheel-brake cyl.)
V = Brake line to brake master cylinder (brake circuit for front axle)
H = Brake line to brake master cylinder (brake circuit for rear axle)

Caution!
Under no circumstances may the hexagon-socket-head cap screws be loosened.
After loosening, it is no longer possible to get the brake circuits leak-tight or they can no longer be bled.
Danger!

TEST STEP 37

Trouble-shooting (continued)

- Rest of the brake system OK? Properly bled?
 Brake-line connections not leaking? Brake pads OK?
 Brake pads must not be "glazed". Brake discs OK?
 Brake must "grip" well.
 Brake master cylinder and wheel-brake cylinder OK?
 Wheel-brake cylinder and brake pads must move freely.
 Clean if necessary.
- Check ground terminals on pump motor and vehicle body.
- Check positive terminal on pump motor.
- Replace hydraulic modulator.

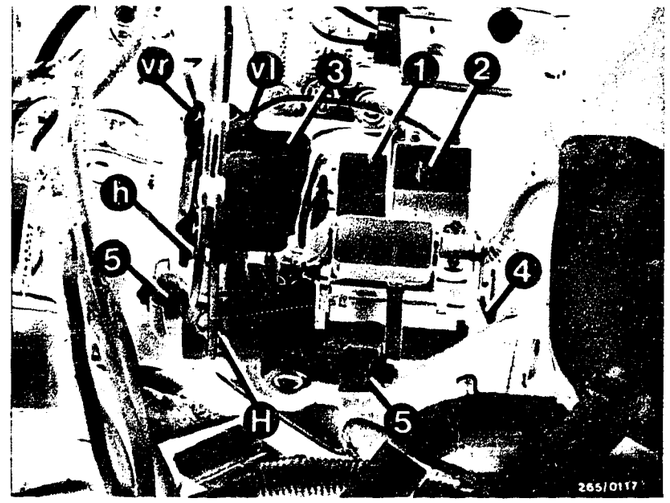
TEST STEP 38

Operation:	Reading:	Testing:
Program selector switch position **21** Additional operation: • Let engine run. • Select wheel FR with key FR. • Press brake pedal until instrument on dynamic brake analyzer indicates 2000 N (200 kgf) for the right-hand side. • Brake pedal force must not be changed throughout the entire testing procedure. • Press illuminated key continuously until test is completed (approx. 10 seconds) • Read off right-hand reading. • Release brake pedal and illuminated key (follow the sequence of operations so that the vehicle does not jump out of the rollers).	Instruments on dynamic brake analyzer Right-hand reading drops briefly to an intermediate value and then rises again to 500...1400 N (50...140 kp) If reading O.K., continue testing with next test step.	Component: Hydraulic modulator Operation: Pressure buildup in brake lines front right Malfunction: Braking-force reading less than 500 N or greater than 1400 N

Trouble-shooting

- Repeat the test twice and make sure that the braking force is not changed during the testing procedure.
 Repeat test possibly with engine stopped and without operation of brake booster.

Continued on G 22



1 = Valve relay
2 = Return-pump relay
l = Connection for brake line front left (wheel-brake cyl.)
r = Connection for brake line front right (wheel-brake cyl.)
h = Connection for brake line rear axle (wheel-brake cyl.)
V = Brake line to brake master cylinder (brake circuit for front axle)
H = Brake line to brake master cylinder (brake circuit for rear axle)

Caution!
Under no circumstances may the hexagon-socket-head cap screws be loosened.
After loosening, it is no longer possible to get the brake circuits leak-tight or they can no longer be bled.
Danger!

TEST STEP 38

Trouble-shooting (continued)

- Rest of the brake system OK? Properly bled?
 Brake-line connections not leaking? Brake pads OK?
 Brake pads must not be "glazed". Brake discs OK?
 Brake must "grip" well.
 Brake master cylinder and wheel-brake cylinder OK?
 Wheel-brake cylinder and brake pads must move freely.
 Clean if necessary.
- Check ground terminals on pump motor and vehicle body.
- Check positive terminal on pump motor.
- Replace hydraulic modulator.

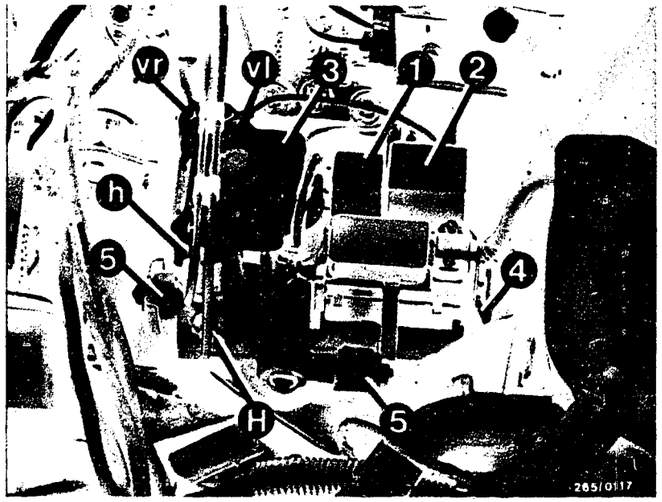
TEST STEP 39

Operation:		Reading:	Testing:
Program-selector switch position	22	Instruments on dynamic brake analyzer: After twice pressure reduction without return pump the pump is switched on briefly. Brake pedal comes back slightly when pump switches on. Then left-hand brake force reading must drop below 400 N (40 kgf) The test specification is indicated only for approx. 2.5 seconds and then rises again to the full braking force. If reading O.K., continue testing with next test step.	Component: Hydraulic modulator Operation: Pump delivery Front axle brake circuit Malfunction: Braking force reading greater than 400 N.

Additional operation:
- Let engine run.
- Switch on both brake rollers.
- Select wheel FL with key FL.
- Press brake pedal until instrument of dynamic analyzer indicates 2000 N (200 kgf) for left-hand side.
- Brake pedal force must not be changed throughout the entire test procedure.
- Press illuminated key until test is completed (approx. 10 seconds).
- Make reading on left.
- Release brake pedal and illuminated key (keep to sequence of operations so that vehicle does not jump out of rollers).

Trouble-shooting:
- Repeat test twice and make sure that brake circuit is not changed during testing. Possibly repeat test with engine stopped and without operation of brake booster.

Continued on H 1



1 = Valve relay
2 = Return-pump relay
l = Connection for brake line front left (wheel-brake cyl.)
r = Connection for brake line front right (wheel-brake cyl.)
h = Connection for brake line rear axle (wheel-brake cyl.)
V = Brake line to brake master cylinder (brake circuit for front axle)
H = Brake line to brake master cylinder (brake circuit for rear axle)

Caution!
Under no circumstances may the hexagon-socket-head cap screws be loosened.
After loosening, it is no longer possible to get the brake circuits leak-tight or they can no longer be bled.
Danger!

TEST STEP 39

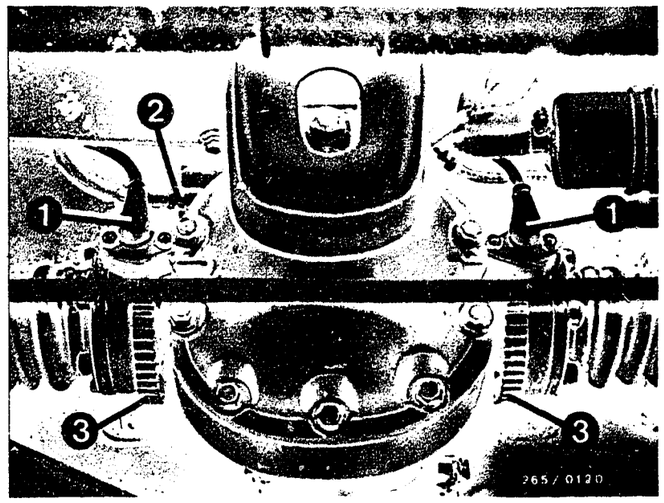
Trouble-shooting (continued)

- Rest of the brake system OK? Properly bled?
 Brake-line connections not leaking? Brake pads OK?
 Brake pads must not be "glazed". Brake discs OK?
 Brake must "grip" well.
 Brake master cylinder and wheel-brake cylinder OK?
 Wheel-brake cylinder and brake pads must move freely.
 Clean if necessary.
- Check ground terminals on pump motor and vehicle body.
- Check positive terminal on pump motor.
- Replace hydraulic modulator.

Rear axle - Carry out program-selector switch position 23 first since it is assumend for the following test steps that the wheel-speed sensors are in proper working order.

TEST STEP 40

Operation:		Reading:	Testing:
Program-selector switch position	23	Digital display unit must indicate 1.8 ... 19 In case of fluctuating readings, the lowest reading is valid. Note: If reading is 1.8, check air gap. If reading O.K., continue testing with next test step.	Component: Rear left wheel-speed sensor Operation: Wheel-speed sensor signal Malfunction: Reading less than 1.8 or greater than 19
Additional operation: • Drive rear wheels of vehicle onto dynamic brake analyzer. • Switch on ignition. • Select wheel RL with key RL. • Switch on left-hand brake roller. • Make reading.			



1 = Wheel-speed sensor
2 = Wheel-speed sensor plug connector

Trouble-shooting (switch off ignition)

A reading of 999 signifies:

- Speed of dynamic brake analyzer too great (above approx. 13 km/h).

Reading 0 or less than 1.8

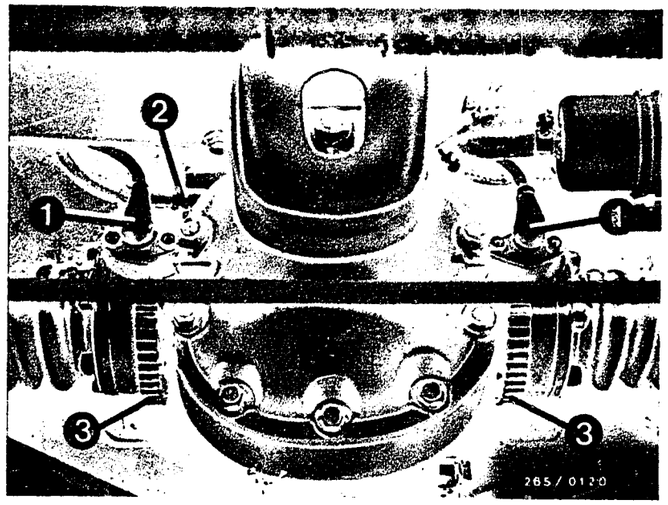
- Wheel-speed sensors mixed up? Check assignment:
 Wheel-speed sensors must be connected to the specified wheel and controller input (see circuit diagram).
- Air gap between wheel-speed sensor and ring gear too great. Check installation.
- Check wheel bearing play.
- Replace wheel-speed sensor.

Continued on H 4/H 5

Trouble-shooting - TEST STEP 40 (continued)

Reading 0 or less than 1.8:

- Be sure to remedy fault before continuing testing with program switch positions 20, 21 and 22.
- Wheel-speed sensors mixed up? Check assignment: wheel-speed sensors must be connected to the specified wheel and controller input (see circuit diagram).
- Air gap between wheel-speed sensor and ring gear too big. Check fitting.
- Check wheel bearing play.
- Replace wheel-speed sensor.



1 = Wheel-speed sensor
2 = Wheel-speed sensor plug connector
3 = Ring gear

Removing the wheel-speed sensors

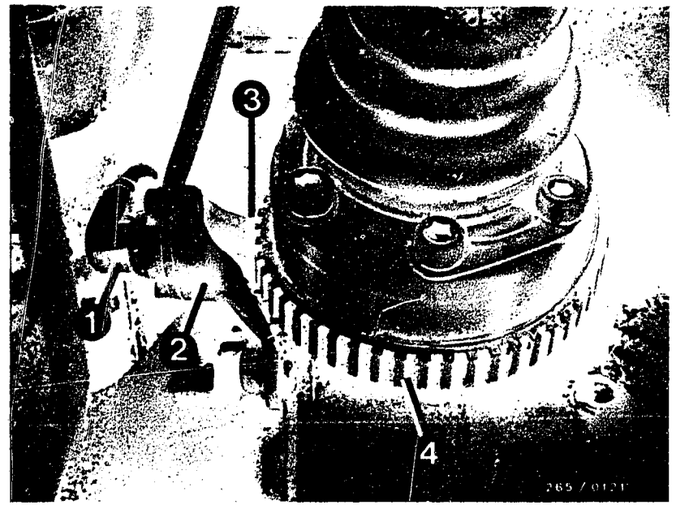
- Switch off ignition.
- Take plug connector out of holder and take apart.
- Take wheel-speed sensor lead out of fastening clamps.
- Loosen fastening screws for wheel-speed sensor. Do not unscrew holding bracket. Pull out wheel-speed sensor. Do not use force. Do not lose shims.

Continued on H6/H7

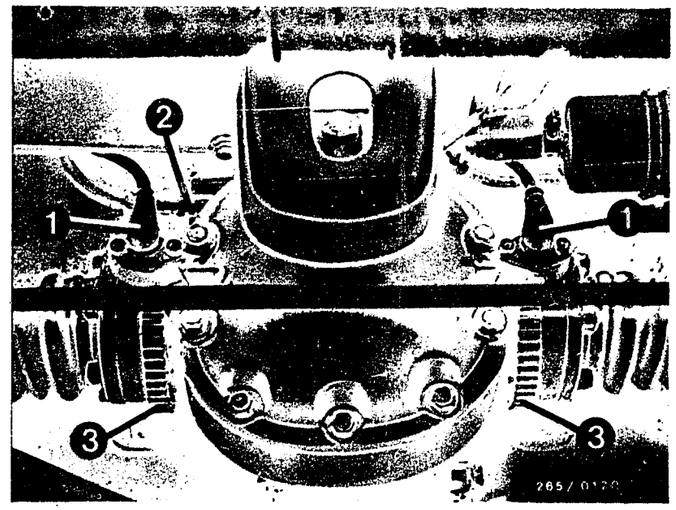
Trouble-shooting for TEST STEP 40 (continued)

Installing the wheel-speed sensors on the rear axle

- Check O-ring for cracks and replace if necessary.
- Only take new wheel-speed sensor out of protective sleeve when ready for mounting.
- Grease wheel-speed sensor housing lightly with Molykote Longterm 2. Mount shim(s).
- Make sure that no metallic foreign bodies are on the permanently magnetic edge.
- Carefully press wheel-speed sensor into mounting hole as far as it will go. Do not knock.
- Measure air gap between wheel-speed sensor edge and ring gear with feeler gauge. Gap should be 0.3...1.0 mm. If necessary, correct air gap with shims.
- Use new micro-encapsulated fastening screws. Tighten fastening screws to min. 8 Nm.
- Re-secure lead at the intended places.
- Connect wheel-speed sensor to ABS wiring harness and clip plug connector into holder.
- After repairing, test with ABS tester.



1 = Wheel-speed sensor
2 = Holding bracket
3 = Air gap
4 = Ring gear

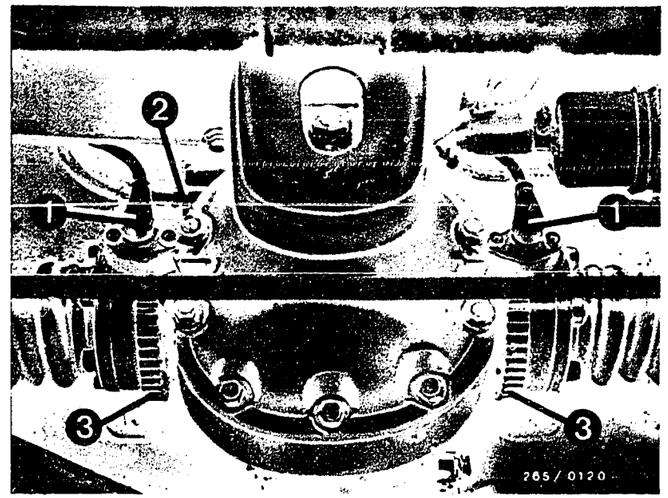


1 = Wheel-speed sensor
2 = Wheel-speed sensor plug connector

Rear axle - Carry out program-selector switch position 23 first since it is assumend for the following test steps that the wheel-speed sensors are in proper working order.

TEST STEP 41

Operation:		Reading:	Testing:
Program-selector switch position	23	Digital display unit must indicate 1.8 ... 19 In case of fluctuating readings, the lowest reading is valid. Note: If reading is 1.8, check air gap. If reading O.K., continue testing with next test step.	Component: Rear right wheel-speed sensor Operation: Wheel-speed sensor signal Malfunction: Reading less than 1.8 or greater than 19
Additional operation: • Drive rear wheels of vehicle onto dynamic brake analyzer. • Switch on ignition. • Select wheel RR with key RR. • Switch on left-hand brake roller. • Make reading.			



1 = Wheel-speed sensor
2 = Wheel-speed sensor plug connector

Trouble-shooting (switch off ignition)

A reading of 999 signifies:

- Speed of dynamic brake analyzer too great (above approx. 13 km/h).

Reading 0 or less than 1.8

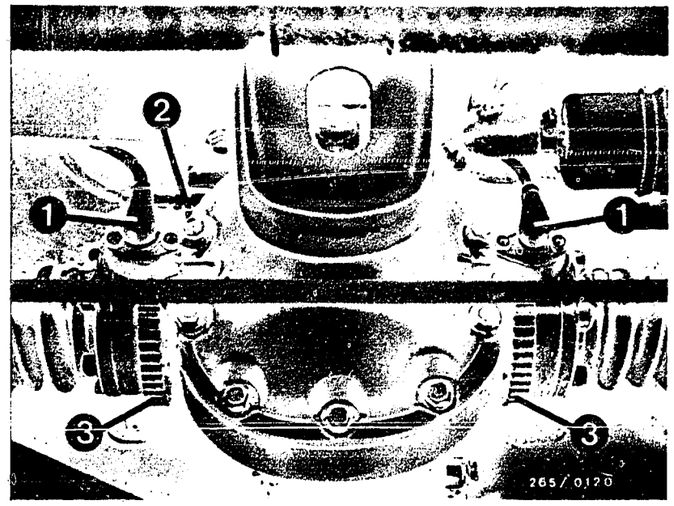
- Wheel-speed sensors mixed up? Check assignment: Wheel-speed sensors must be connected to the specified wheel and controller input (see circuit diagram).
- Air gap between wheel-speed sensor and ring gear too great. Check installation.
- Check wheel bearing play.
- Replace wheel-speed sensor.

Continued on H 11/H 12

Trouble-shooting - TEST STEP 41 (continued)

Reading 0 or less than 1.8:

- Be sure to remedy fault before continuing testing with program switch positions 20, 21 and 22.
- Wheel-speed sensors mixed up? Check assignment: wheel-speed sensors must be connected to the specified wheel and controller input (see circuit diagram).
- Air gap between wheel-speed sensor and ring gear too big. Check fitting.
- Check wheel bearing play.
- Replace wheel-speed sensor.



1 = Wheel-speed sensor
2 = Wheel-speed sensor plug connector
3 = Ring gear

Removing the wheel-speed sensors

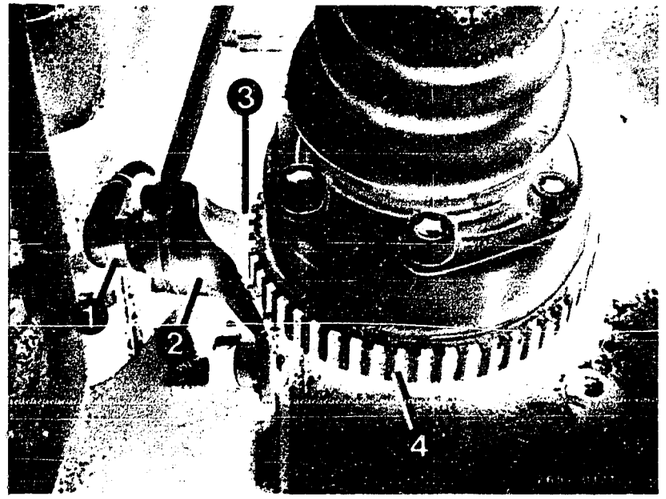
- Switch off ignition.
- Take plug connector out of holder and take apart.
- Take wheel-speed sensor lead out of fastening clamps.
- Loosen fastening screws for wheel-speed sensor. Do not unscrew holding bracket. Pull out wheel-speed sensor. Do not use force. Do not lose shims.

Continued on H 12/H 13

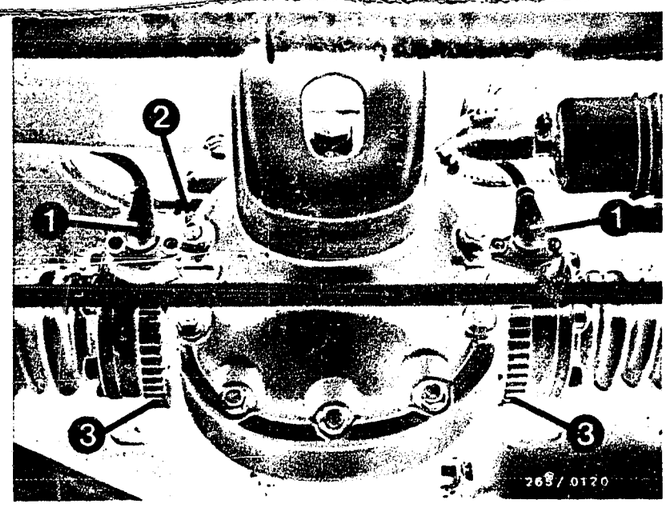
Trouble-shooting for TEST STEP 41 (continued)

Installing the wheel-speed sensors on the rear axle

- Check O-ring for cracks and replace if necessary.
- Only take new wheel-speed sensor out of protective sleeve when ready for mounting.
- Grease wheel-speed sensor housing lightly with Molykote Longterm 2. Mount shim(s).
- Make sure that no metallic foreign bodies are on the permanently magnetic edge.
- Carefully press wheel-speed sensor into mounting hole as far as it will go. Do not knock.
- Measure air gap between wheel-speed sensor edge and ring gear with feeler gauge. Gap should be 0.3...1.0 mm. If necessary, correct air gap with shims.
- Use new micro-encapsulated fastening screws. Tighten fastening screws to min. 8 Nm.
- Re-secure lead at the intended places.
- Connect wheel-speed sensor to ABS wiring harness and clip plug connector into holder.
- After repairing, test with ABS tester.



1 = Wheel-speed sensor
2 = Holding bracket
3 = Air gap
4 = Ring gear



1 = Wheel-speed sensor
2 = Wheel-speed sensor plug connector

TEST STEP 42

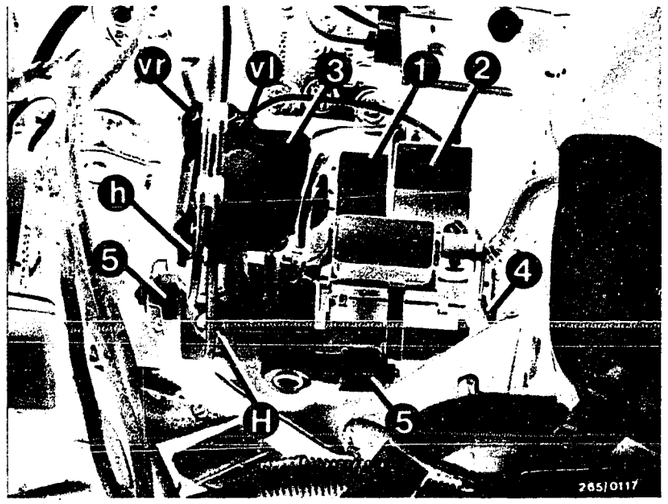
Operation:		Reading:	Testing:
Program-selector switch position	20	Instruments of dynamic brake analyzer: Left-hand and right hand reading moves to a value below 1000 N (100 kgf) If reading O.K. continue testing with next test step.	Component: Hydraulic modulator, rear axle Operation: Mixing up of brake lines Malfuntion: Reading does not drop

Additional operation:

- Let engine run.
- Select program switch position 20.
- Select rear axle with key RA.
- Switch on brake roller.
- Produce 2000 N (200 kgf) braking force with brake pedal.
- Press illuminated key.
- There must be pressure reduction on both wheels.
- Release brake pedal and illuminated key.
 (Follow sequence of operations so that vehicle does not jump out of rollers).

Trouble-shooting:

- Lamp 2 (red) must not light up.
- Repeat test.
- Brake lines mixed up on hydraulic modulator?
 Follow markings.
- Correct key (RA) pressed?
- Replace hydraulic modulator.



1 = Valve relay
2 = Return-pump relay
l = Connection for brake line front left (wheel-brake cyl.)
r = Connection for brake line front right (wheel-brake cyl.)
h = Connection for brake line rear axle (wheel-brake cyl.)
V = Brake line to brake master cylinder (brake circuit for front axle)
H = Brake line to brake master cylinder (brake circuit for rear axle)

Caution!
Under no circumstances may the hexagon-socket-head cap screws be loosened.
After loosening, it is no longer possible to get the brake circuits leak-tight or they can no longer be bled.
Danger!

TEST STEP 43

Operation:		Reading:	Testing:
Program-selector switch position	20	Instruments on dynamic brake analyzer: Reading moves to a value below 1000 N (100 kgf) If reading O.K., continue testing with next test step.	Component: Hydraulic modulator Operation: Pressure reduction in rear axle brake lines Malfunction: Braking force reading greater than 1000 N

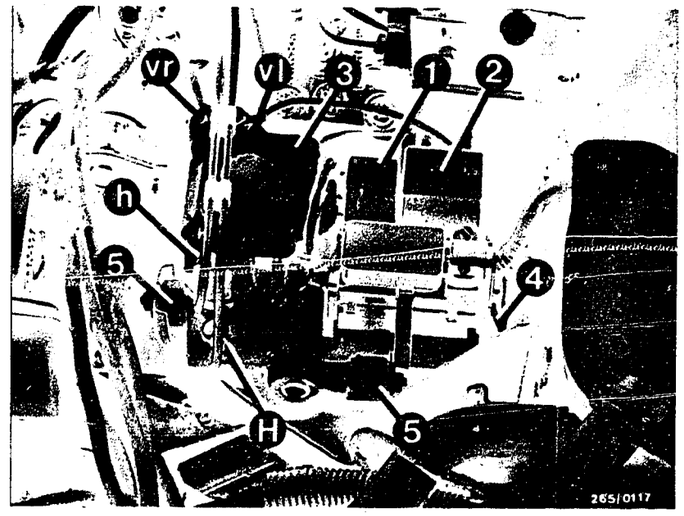
Additional operation:

- Let engine run.
- Switch on left-hand and right-hand brake rollers.
- Select rear axle with key RA.
- Press brake pedal until instrument on dynamic brake analyzer shows 2000 N (200 kp) for the left-hand side.
 Brake pedal force must not be changed throughout the entire measuring procedure.
- Right-hand reading may differ by no more than 500 N (50 kgf) from the left-hand reading.
- Press illuminated key until test is completed (approx. 10 seconds).
- Read off reading.
- Release brake pedal and illuminated key (follow the sequence of operations so that the vehicle does not jump out of the rollers).

Trouble-shooting:

- Lamp 2 (red) must not light up.
- Repeat the test twice and make sure that the braking force ist not changed during the testing procedure.

Continued on H 18



1 = Valve relay
2 = Return-pump relay
l = Connection for brake line front left (wheel-brake cyl.)
r = Connection for brake line front right (wheel-brake cyl.)
h = Connection for brake line rear axle (wheel-brake cyl.)
V = Brake line to brake master cylinder (brake circuit for front axle)
H = Brake line to brake master cylinder (brake circuit for rear axle)

Caution!
Under no circumstances may the hexagon-socket-head cap screws be loosened.
After loosening, it is no longer possible to get the brake circuits leak-tight or they can no longer be bled.
Danger!

TEST STEP 43

Trouble-shooting (continued)

- Rest of the brake system OK? Properly bled?
 Brake-line connections not leaking? Brake pads OK?
 Brake pads must not be "glazed". Brake discs OK?
 Brake must "grip" well.
 Brake master cylinder and wheel-brake cylinder OK?
 Wheel-brake cylinder and brake pads must move freely.
 Clean if necessary.
- Check ground terminals on pump motor and vehicle body.
- Check positive terminal on pump motor.
- Replace hydraulic modulator.

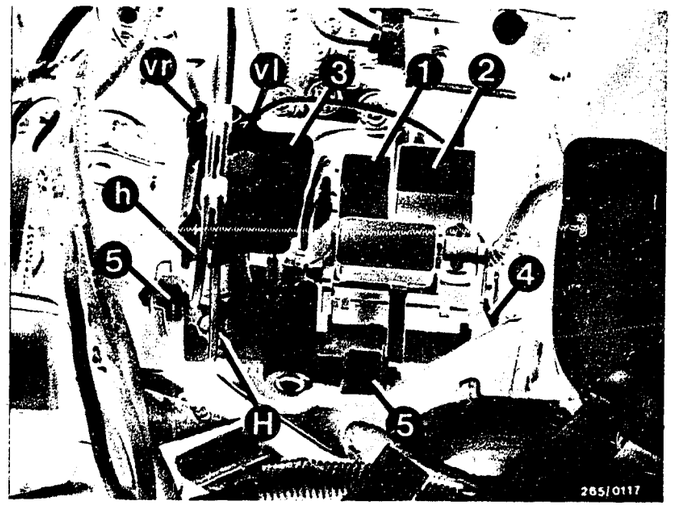
TEST STEP 44

Operation:		Reading:	Testing:
Program-selector switch position	21	Instruments on dynamic brake analyzer: Left-hand reading drops briefly to an intermediate value and then rises again to 500...1400 N (50...140 kp).	Component: Hydraulic modulator
Additional operation: • Let engine run. • Switch on both brake rollers. • Select rear axle with key RA. • Press brake pedal until instrument on dynamic brake analyzer shows 2000 N (200 kp) for the left-hand side. • Pedal force must not be changed throughout the entire test procedure. • Press illuminated key until test is completed (approx. 10 seconds). • Make reading on left. • Release brake pedal and illuminated key (keep to sequence of operations so that vehicle does not jump out of rollers).		If reading O.K., continue testing with next test step.	Operation: Pressure buildup in rear-axle brake lines Malfunction: Braking-force reading less than 500 N or greater than 1400 N

Trouble-shooting:

- Repeat the test twice and make sure that the braking force is not changed during the testing procedure (let the engine run).

Continued on H 21



1 = Valve relay
2 = Return-pump relay
l = Connection for brake line front left (wheel-brake cyl.)
r = Connection for brake line front right (wheel-brake cyl.)
h = Connection for brake line rear axle (wheel-brake cyl.)
V = Brake line to brake master cylinder (brake circuit for front axle)
H = Brake line to brake master cylinder (brake circuit for rear axle)

Caution!
Under no circumstances may the hexagon-socket-head cap screws be loosened.
After loosening, it is no longer possible to get the brake circuits leak-tight or they can no longer be bled.
Danger!

TEST STEP 44

Trouble-shooting (continued)

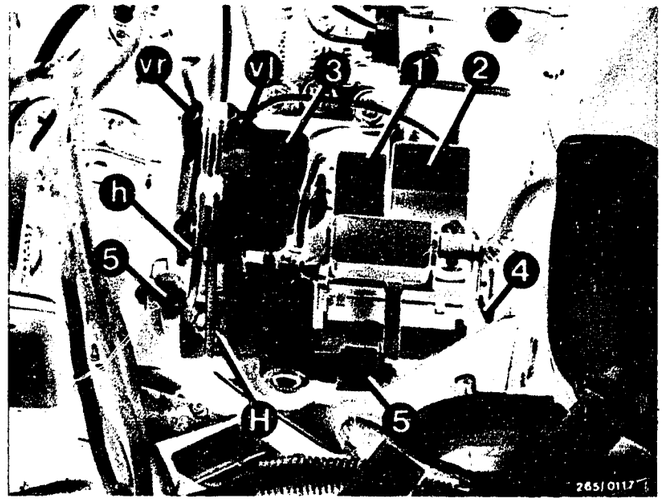
- Rest of the brake system OK? Properly bled?
 Brake-line connections not leaking? Brake pads OK?
 Brake pads must not be "glazed". Brake discs OK?
 Brake must "grip" well.
 Brake master cylinder and wheel-brake cylinder OK?
 Wheel-brake cylinder and brake pads must move freely.
 Clean if necessary.
- Check ground terminals on pump motor and vehicle body.
- Check positive terminal on pump motor.
- Replace hydraulic modulator.

TEST STEP 45

Operation:		Reading:	Testing:
Program-selector switch position	22	Reading: Instruments on dynamic brake analyzer: After 2x pressure reduction without return pump, pump cuts in briefly. Brake pedal comes back slightly when pump cuts in. Then braking-force reading must drop below 400 N (40 kp) The reading is shown only for approx. 2.5 seconds and then rises again to the full braking force. If reading O.K., continue testing with next test step.	Component: Hydraulic modulator Operation: Pump delivery Brake circuit for rear axle Malfunction: Braking force reading greater than 400 N

Additional operation:

- Let engine run.
- Select rear wheels with key RA.
- Switch on both brake rollers.
- Press brake pedal until instrument shows 2000 N (200 kp) for the right-hand side.
- Pedal force must not be changed throughout the entire test procedure.
- Press illuminated key until test is completed (approx. 10 seconds).
- Make reading.
- Release brake pedal and illuminated key (keep to sequence of operations so that vehicle does not jump out of rollers).



1 = Valve relay
2 = Return-pump relay
l = Connection for brake line front left (wheel-brake cyl.)
r = Connection for brake line front right (wheel-brake cyl.)
h = Connection for brake line rear axle (wheel-brake cyl.)
V = Brake line to brake master cylinder (brake circuit for front axle)
H = Brake line to brake master cylinder (brake circuit for rear axle)

Caution!
Under no circumstances may the hexagon-socket-head cap screws be loosened.
After loosening, it is no longer possible to get the brake circuits leak-tight or they can no longer be bled.
Danger!

Trouble-shooting:

- Repeat test twice and make sure that braking force is not changed during testing.

Continued on H 24

TEST STEP 45

Trouble-shooting (continued)

- Rest of the brake system OK? Properly bled?
 Brake-line connections not leaking? Brake pads OK?
 Brake pads must not be "glazed". Brake discs OK?
 Brake must "grip" well.
 Brake master cylinder and wheel-brake cylinder OK?
 Wheel-brake cylinder and brake pads must move freely.
 Clean if necessary.
- Check ground terminals on pump motor and vehicle body.
- Check positive terminal on pump motor.
- Replace hydraulic modulator.

REPLACING THE HYDRAULIC MODULATOR
(applies to test steps 33...39 and 42...45)

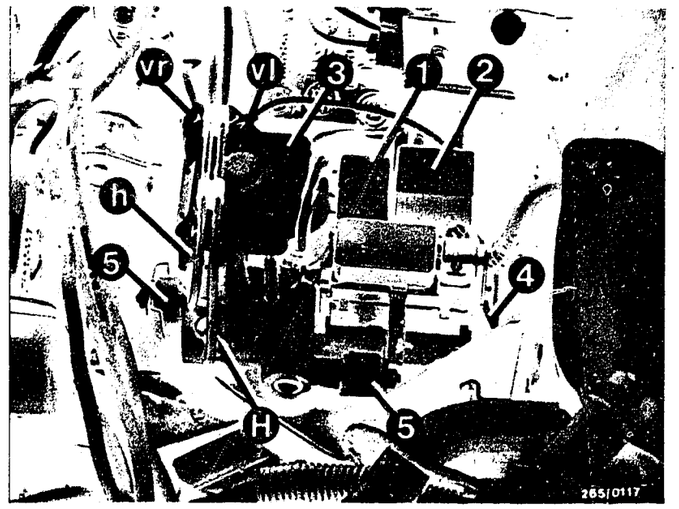
Removing the hydraulic mudulador

- For safety reasons, the hydraulic modulator must not be repaired, but the complete unit must be replaced.
 Exceptions to this are the return-pump relay and the valve relay. Both relays may be replaced.

- Apart from the brake-line connections, no screws on the hydraulic modulator may be loosened or removed. Under no circumstances may the hexagon-socket-head cap screws (arrows) be loosened. After loosening, it is no longer possible to get the brake circuits leak-tight or the brake circuits can no longer be bled.
 Danger!

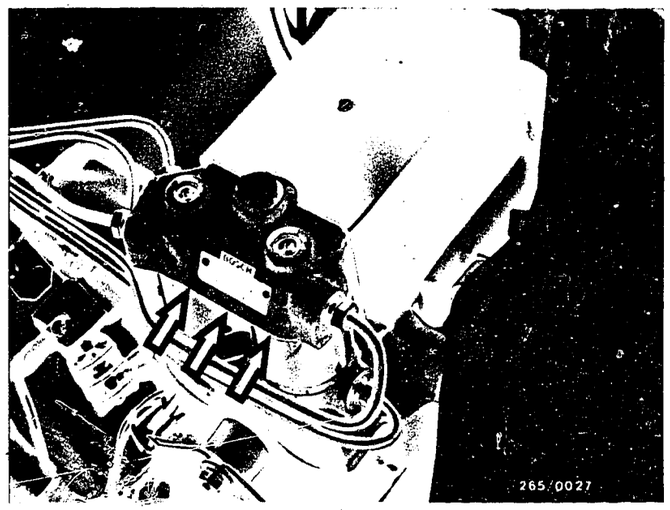
- Visually inspect hydraulic modulator and brake-line connections for leaks. Pay particular attention to the joints identified by arrows (bottom picture). If brake fluid is escaping, tighten the brake-line connections (12...16 Nm) or replace the hydraulic modulator.

Continued on J 1/J 2



1 = Valve relay
2 = Motor relay
3 = Hydraulic modulator
4 = Pump motor ground terminal
5 = Fastening screws

Arrows = Joints



Removing the hydraulic modulator (continued)

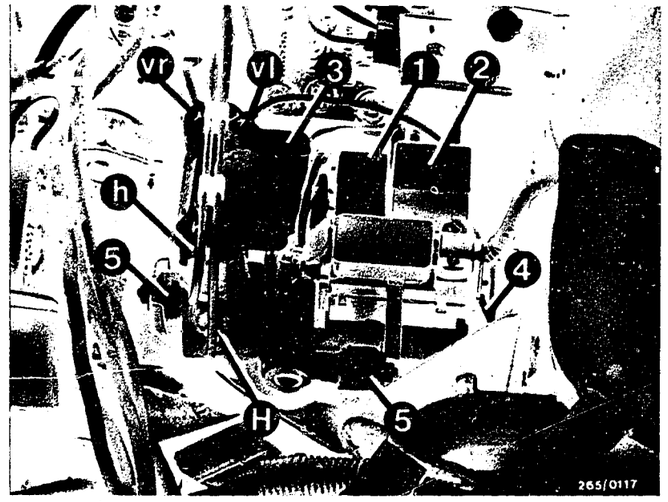
On the base of the hydraulic modulator there is a vent hole to the pump pistons. A slight escape of brake fluid is possible at this point.
A complaint is justified only if, after repeated operation of the brake pedal, there is a pool of brake fluid under the hydraulic modulator.

- When removing and installing the brake lines, make sure that the lines are marked in accordance with the markings on the hydraulic modulator and that they are not mixed up when re-connecting (e.g. FL of hydraulic modulator must be connected to the front left wheel brake cylinder).

- Markings on hydraulic modulator

VL = Connection for brake line front left (wheel brake cylinder)
VR = Connection for brake line front right (wheel brake cylinder)
HR = Connection for brake line rear right (wheel brake cylinder)

V = Front axle brake circuit from brake master cylinder
H = Rear axle brake circuit from brake master cylinder

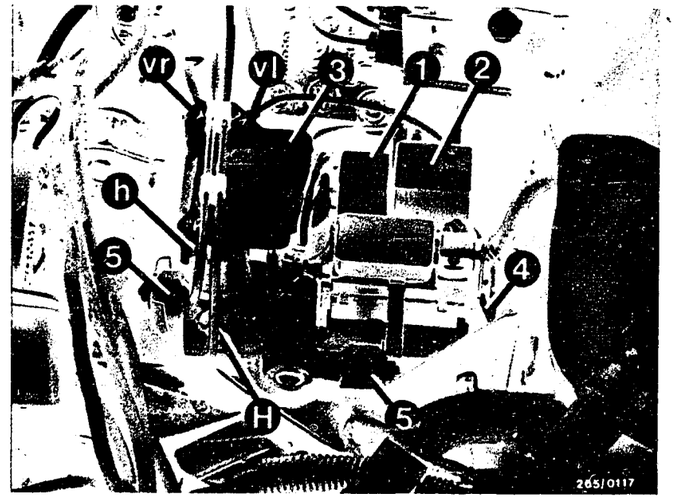


1 = Valve relay
2 = Motor relay
3 = Hydraulic modulator
4 = Pump motor ground terminal
5 = Fastening screws

Continued on J 3/J 4

Removing the hydraulic modulator (continued)

- Use only the specified double-end flare nut wrench 9x11 mm for loosening and tightening the brake lines.
- Mark brake lines and remove from hydraulic modulator.
- Catch the brake fluid and do not bring it into contact with your skin or clothing or with paintwork.
- Immediately seal the brake lines and connections with dummy plugs.
- Disconnect ground lead from pump motor.
- Loosen fastening screw and take off cover.
- Loosen bracket and take off the plug.
- Loosen hexagon nuts from holder and take off hydraulic modulator.



1 = Valve relay
2 = Motor relay
3 = Hydraulic modulator
4 = Pump motor ground terminal
5 = Fastening screws

Installation

- Mount hydraulic modulator in the holder and fasten with the hexagon nuts.
- Connect ground cable to pump motor. Plug on 12-pin plug and fasten with the bracket.
- Secure cover on hydraulic modulator with the screw.
- Connect the brake lines to the hydraulic modulator in accordance with the markings.
- Observe the tightening torque for the brake-line connections on the hydraulic modulator: 12...16 Nm.
- Bleed the brake system and check for leaks.
- Fully test the ABS with the tester.

Testing with the ABS tester is now completed.
Finally, perform a road test.
With the engine running, the indicator lamp must go out.
Drive at at least 30 km/h. Indicator lamp must not come on again.

Technical Bulletin

Only for use within the Bosch organization. No to be communicated to any third party.

NO REPAIRS PERMITTED/
MAXIMUM ALLOWABLE SHELF LIFE
FOR ABS HYDRAULIC MODULATORS

VDT-I 265/102 En
7.1984
supersedes edition 1.1980

1. No repairs permitted

The passenger-car ABS is a piece of safety equipment. As a result of unauthorized interference with the ABS components there is the danger that the efficient operation of the ABS system will be adversely affected.

> We would point out, therefore, that the hydraulic modulator must under no circumstances be repaired. For safety reasons it must be exchanged as a complete unit.

It is only permitted to exchange the motor and valve relay. All other screws and plugs must not be loosened.

2. Maximum allowable shelf life

The maximum allowable shelf life for hydraulic modulators is 2 years, reckoned from the production date (FD) given on the product. When the maximum shelf life is reached, the hydraulic modulator must be subjected to a functional check.
This functional check can only be performed in the specialist department of Robert Bosch GmbH. Once checked, the hydraulic modulators are identified with L and new FD. After a further 2 years, i.e. after a total of 4 years shelf life, it is necessary for all rubber and plastic parts to be exchanged at the factory.

Service workshops outside Germany should send the hydraulic modulators to:

Robert Bosch GmbH
KH/LAV 2 - Auspackraum
z. W. an K1 / VAK 2
Auf der Breit 4

7500 Karlsruhe 41.

The hydraulic modulators should be sent in to us postage-paid. On the enclosed delivery note please quote this Technical Bulletin.

The functional check is performed subject to payment.

Published by:

Robert Bosch GmbH
Division KH
Technical After-Sales Service (KH/VKD 2)

Please direct questions and comments concerning the contents to our authorized representative in your country.

Edmund Klaiss OHG
Bosch-Vertragsgroßhändler
Neuenkamper Str. 22 - 28
5630 Remscheid

Ludwig Klaps KG
Bosch-Vertragsgroßhändler
Hemelter Str. 74 - 78
4440 Rheine

Karl Schmitz KG
Bosch-Vertragsgroßhändler
Sonnenstraße 3
8200 Rosenheim

Marx GmbH
Bosch-Dienst
Heinrich-Hertz-Straße 11
2380 Schleswig

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Werner-von-Siemens-Str. 6
8720 Schweinfurt

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Bosch-Vertragsgroßhändler
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5900 Siegen 1

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Bosch-Dienst
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2160 Stade /Elbe

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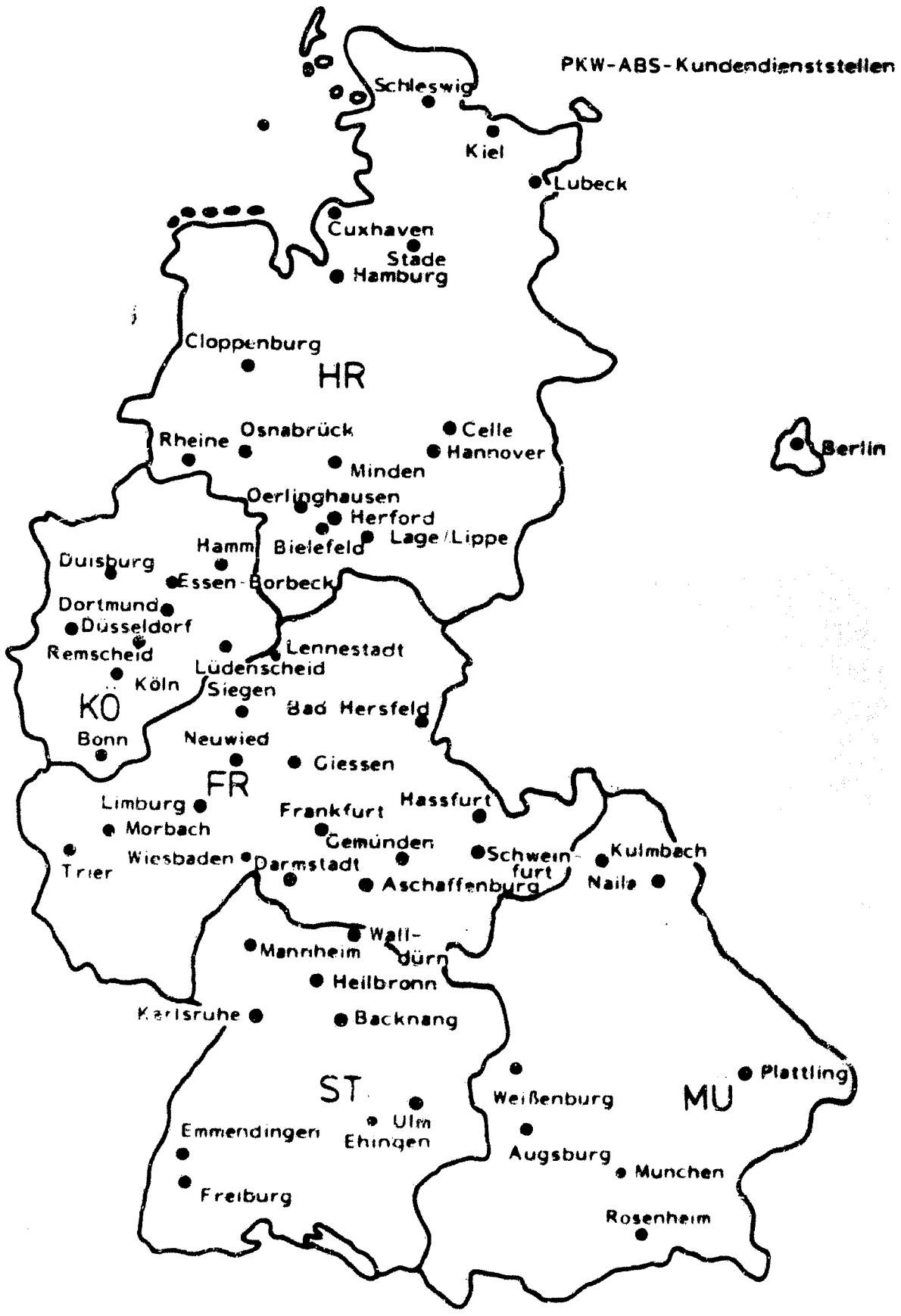
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Bosch-Vertragsgroßhändler
Metternichstraße 6
5500 Trier

Julius Mack GmbH & Co. KG
Bosch-Dienst
Herrlinger Straße 64
7900 Ulm (Donau)

Wörner GmbH & Co. KG
Bosch-Dienst
Würzburger Str. 26
6968 Walldürn

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Bosch-Dienst
Nürnberger Str. 53
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	D a v a s a San Isidro, 15 M u r c i a Tel.: 968/23 86 00 - 23 86 04

ASIEN

Japan

Robert Bosch (Japan) Ltd.
Workshop
522, Idasugiyama-cho, Nakahara-ku
Kawasaki 211
Tel.: (044) 751-4592

NORDAMERIKA

Kanada

Robert Bosch (Canada) Ltd.
6811 Century Avenue
Mississauga, Ontario L5N 1R1
Tel.: (416) 826-6060

U.S.A.

Robert Bosch Corporation
2800 South, 25th Avenue
Broadview, Illinois 60153
Tel.: (312) 681-5000

Verantwortlich:

Robert Bosch GmbH
Geschäftsbereich KH
Techn. Kundendienst (KH/VKD 2)

Anfragen außerhalb der Bundesrepublik Deutschland sind an die jeweilige RG/AV zu richten.

Technische Mitteilung

Nur zum internen Gebrauch. Weitergabe an Dritte nicht gestattet.

INSTANDSETZUNGSVERBOT / HÖCHSTZULÄSSIGE LAGERZEIT FÜR ABS-HYDROAGGREGATE

VDT-I 265/102 De
7.1984
ersetzt Ausgabe 1.1980

1. Reparaturverbot

Beim PKW-ABS handelt es sich um eine Sicherheitseinrichtung. Durch unzlässige Eingriffe in die ABS-Komponenten besteht die Gefahr, daß die einwandfreie Funktion der ABS-Anlage beeinträchtigt wird.

Wir weisen deshalb darauf hin, daß das Hydroaggregat unter keinen Umständen instandgesetzt, sondern aus Sicherheitsgründen nur komplett ausgetauscht werden darf.

Zulässig ist nur der Austausch von Motor- und Ventilrelais. Alle übrigen Schrauben und Verschlußstopfen dürfen nicht gelöst werden.

2. Höchstzulässige Lagerzeit

Die höchstzulässige Lagerzeit für Hydroaggregate beträgt, gerechnet ab dem auf dem Erzeugnis angegebenen Fertigungsdatum (FD), 2 Jahre. Bei Erreichen der Höchstlagerzeit muß das Hydroaggregat einer Funktionsüberprüfung unterzogen werden.
Diese Funktionsüberprüfung kann nur in der Fachabteilung der Robert Bosch GmbH durchgeführt werden. Die überprüften Hydroaggregate werden mit ⊔ und neuem FD gekennzeichnet. Nach weiteren 2 Jahren, also insgesamt

4 Jahren Lagerzeit, ist ein Austausch aller Gummi- und Kunststoffteile im Werk notwendig.

Deutsche Kundendienststellen senden die Hydroaggregate an:

Robert Bosch GmbH
Abt. K1 / VAK 2
Robert-Bosch-Straße

7141 Schwieberdingen

Kundendienststellen aus den übrigen Ländern bitten wir, die Hydroaggregate an:

Robert Bosch GmbH
KH/LAV 2 - Auspackraum
z. W. an K1 / VAK 2
Auf der Breit 4

7500 Karlsruhe 41

einzusenden.

Die Hydroaggregate sind kostenfrei für uns einzusenden. Auf dem beigefügten Lieferschein nehmen Sie bitte Bezug auf diese Technische Mitteilung.

Die Funktionsüberprüfung wird kostenpflichtig durchgeführt.

Verantwortlich:

Robert Bosch GmbH
Geschäftsbereich KH
Technischer Kundendienst (KH/VKD 2)

Anfragen außerhalb der Bundesrepublik Deutschland sind an die jeweilige RG/AV zu richten.

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